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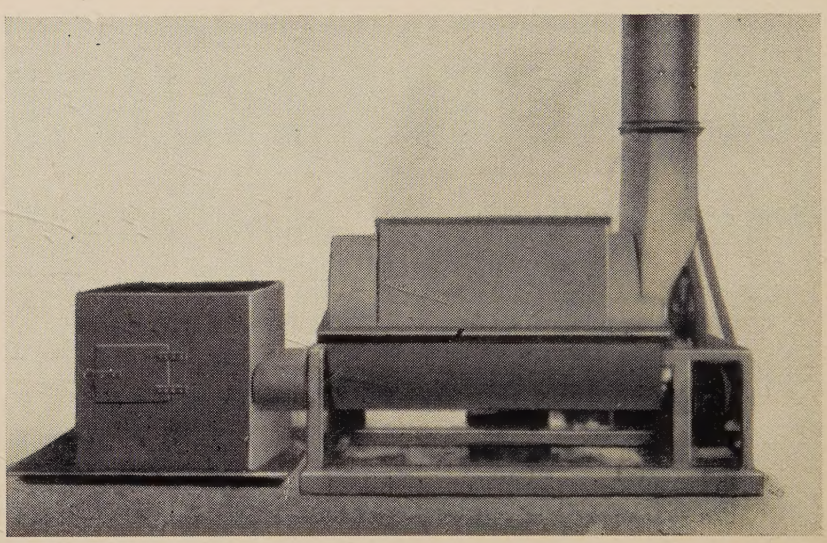

Figure 1. A direct cooker/drier for fish waste. In many types of fisheries activities small amounts of offal or waste become available. These may be difficult to utilize because the usual processing equipment is of large capacity requiring considerable capital investment. The inexpensive cooker/drier shown above may be used for fish meal manufacture where only small amounts of raw material are available. (See the article "Small Scale Manufacture of Fish Meal")

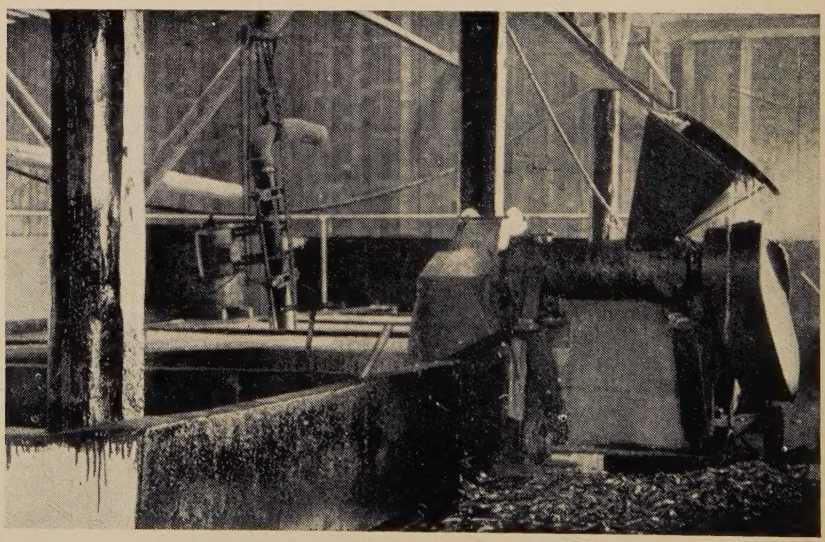

Figure 2. A Danish fish silage plant. The manufacture of fish silage is sometimes a very simple and economic method forutili zing fish waste. In the installation shown above, the minced fish from the hacker is mixed with sulphuric and formic acid in concrete vats, painted internally with bitumen. To facilitate mincing and mixing, up to 20 percent water may be added through the funnel on the grinding mill ; the net contents of fish are always declared on the label of the finished product. (See the article "Acid Preservation of Fish and Fish Offal").

SMALL SCALE MANUFACTURE OF FISH MEAL[1]

When fish are caught, or can be caught, in quantities exceeding a possible outlet for food purposes, it is important that ways of "industrializing" this surplus should be considered. This can be done for instance by converting the raw material into fertilizer or to fish meal for animal and even human consumption. Fertilizer is an inferior product, made from inferior raw material under primitive conditions. It, therefore, commands a much lower price than prime grades of fish meal.

The latter product is most valuable as a source of protein and growth factors in feed rations. This article will not deal with the nutritive side of the problem, however. It is sufficient to say that fish meal is in great demand, and good grades can be sold at very advantageous prices. Even such small quantities as a few hundredweight of fish a day are worth considering for this purpose. Half a ton of fish, for instance, will yield about 125 kg. (275 lb.) fish meal, worth about £ 6. This quantity can be elaborated at very low expense, and may constitute a welcome additional income to the fisherman. A section of this article will, therefore, indicate how to treat such small quantities of fish and with this description and the general information given, the procedure may be modified to suit local conditions.

Such a small scale of manufacture as indicated above, of course, does not justify any costly installation. Where, on the other hand, the raw material available amounts to several tons or more a day, it would be hopeless to rely on primitive, homemade equipment. Some mechanical devices to facilitate operations are necessary. In making suggestions for such cases the aim has again been the greatest simplicity. In the first instance the use of steam has been eliminated, as this involves the installation of an expensive steam boiler, the heat economy is bad, and personnel with some technical skill are required. Furthermore, the use of centrifugal oil separators has been eliminated and the drying operation simplified as much as possible.

For such medium-size or semi-industrial installations the article is limited to the study of only a few schemes which it is felt will prove satisfactory: the last of them can be applied to any quantity down to two tons of fish or fish scrap per day. This method, therefore, deserves careful consideration.

The planning of "full-size" fish meal plants is outside the scope of this article. Even a small factory, with a capacity of, say, 100 tons of fish per day, requires an investment of from £40,000 to £80,000 for fat fish and about half of that for lean fish. The operation of such plants needs skilled and specialized labor and must have a fairly constant supply of raw material over at least a certain period of the year.

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[1]By T. Sparre, Managing Director, Norwegian Herring Oil and Meal Research Institute (Sildolje - og Sildemelindustriens Forskningsinstitutt), Bergen, Norway.

The present article, therefore, first describes the general principles involved in the manufacture of fish meal. The calculations of yields and cost estimates are briefly illustrated. Without such estimates no manufacturing enterprise — except on the most modest and reduced scale — should be undertaken. Finally definite instructions for reduced scale and semi-industrial manufacture are given.

I. General Principles

The composition of the raw material may vary within very wide limits. For the present purpose, the content of non-fat solid matter — mainly protein and phosphates — may be taken at 20 percent. Much more variable and of much greater economical significance is the fat content, which may be anything from less than 1 percent to 20 percent or more.

As it is possible to produce commercial grade meal without removal of the fat when the fat content of the fish is under 3 percent, this figure may well be used as the dividing line between fat and lean fish.

The following example illustrates the necessity of cooking and pressing when processing fat fish.

A. Fat Fish Processing

Assuming a fat content of say 6 percent, and if there are, for instance, 500 kg. of fish to treat, the raw material will consist of :

Solid matter	100 kg.
Fat or oil	30 "
Water	370 "

In other words, the major part of the material is water, which must be eliminated in order to convert the fish to a meal which will keep for some length of time. A good fish meal should not contain much more than 10 percent of moisture ; in this case, this result could be achieved by getting rid of, as calculation shows, about 355 kg. of water. This could be accomplished, for instance, by mincing the fish and extending it to dry in the sun, with constant stirring or turning over. The resulting meal would consist of :

Solid matter	100 kg.
Fat	30 "
Water	15 "
Total	145 kg.

In other words, it would show 10.35 percent moisture and about 20 percent fat.

There are thus two great drawbacks connected with the procedure of direct drying of the fat raw material, and it, of course, holds equally well if artificial drying is resorted to :

1. The meal generally becomes very fatty. Only when the original fat content is less than 3 percent can a meal with less than 10 percent fat be produced in this way. A meal with much fat is generally considered to be of inferior quality, and the oil is lost as a commercial product.
2. To produce 145 kg. meal, 355 kg. water would have to be dried off, i.e. nearly 2½ times the weight of the meal. In artificial drying, where some sort of fuel has to be used, such a procedure is sometimes very costly. Where one relies on natural drying, the time required to dry off all this moisture is often so long that putrefaction, discoloration and all sorts of contamination take place before the moisture content is reduced to a safe limit.

This is the reason for generally resorting to a preliminary cooking and pressing when reducing fat fish. By this means, the protein of the fish is coagulated, the fat cells are ruptured, and the major part of the oil and fat can be pressed out of the raw material. When the cooking is done correctly it is often possible to reduce the moisture content in the pressed material to 50 percent or even less. For the present purpose the more conservative figure of 55 percent moisture and 5 percent fat in the press cake will be used. Before calculating the material balance in this case, the one outstanding drawback of this method should be mentioned. About 20 percent of all the solid matter (consisting almost exclusively of protein) is dissolved in the liquor, is pressed out of the fibers, and is lost for meal production. The amount may be less than 20 percent; in many cases, when raw material is old and partly decomposed, it is much more. Details on this score cannot be entered into here. Of the original 100 kg. of solid matter, only 80 kg. remain, and a press cake with the composition suggested above — 55 percent moisture, 5 percent fat — will thus consist of:

Solid matter	80 kg.
Fat	10 "
Water.	110 "
Total . . .	200 kg.

In order to reduce this to a product with 10 percent moisture, 100 kg. water instead of 355 kg. must be dried off. The yield of meal is, however, reduced from 145 kg. to 100 kg., the fat content to 10 percent. The water to evaporate is thus equal to the weight of the meal instead of being 2½ times as great. This, of course, represents a very great saving in fuel cost and drying equipment where such is installed, in labor of handling, etc.

It must not be forgotten that we have bought these advantages at the expense of 20 percent of the solid matter. The actual figures for the yield would look even worse, as we have only 100 kg. of meal as against 145 kg. by direct drying. However, this is misleading; because this pressed meal has a lower fat content it is of superior

quality, has a higher protein content, and sells at a better price. The fat and the moisture of meals is not paid for, and actually there remains 100 kg. solid matter after direct drying as against 80 kg. after the cooking/pressing process. In addition, practically all the oil, with the exception of the 10 kg. left in the meal can be recovered from the press liquid. The water in this press liquid obviously amounts to $370 - 110 = 260$ kg. plus any water added. With good settling, even without the use of centrifuges, not much more than 1 percent oil should be retained in this liquid, say 3 kg., so that an additional yield of 17 kg. oil is obtained by this process, and this probably more than compensates for the loss of solids.

It goes without saying that much effort has been made to reduce or avoid the loss of solids inherent to the cooking/pressing process. The purified press liquid has been concentrated to a paste of about 50 percent solids, and sold as a separate product, "fish soluble," or this product, or even the defatted dilute press liquid has been reincorporated in the press cake and dried together with it to so-called "wholemeal." It is obvious that such complete utilization of the raw material should be the ultimate aim where the volume of business can justify modern installations. It cannot, however, be considered in this exposé, mainly intended for initial manufacturing undertakings, where simplicity and cheap installations must be the first consideration. We can add that the direct drying process also has been improved, subjecting the dried mass, while still hot, to pressing in hydraulic or continuous screw presses. Thus, the fat content is reduced to 10 percent or less. We get some of the advantages of the cooking process, combined with 100 percent solids yield. The oil obtained by this means is, however, generally dark and of inferior quality.

B. Lean Fish Processing

When processing lean fish (less than 3 percent fat content) there is little lowering of the quality of the meal due to high fat content, regardless of which method is used.

The material balance below illustrates the relative merits of the two general principles when processing fish containing 1 percent fat.

Quantity of fish taken as basis:		500 kg.
Solid matter . .	(20%) . . .	100 kg.
Fat or oil . . .	(1%) . . .	5 "
Water.	(79%) . . .	395 "
		500 kg.

1. Resulting meal when dried directly:

Solid matter.	100 kg.		
Fat or oil.	5 "		
Moisture content, approximately 10%.	12 "		
		117 kg.	total meal produced
		383 "	= " water evapoated
		500 kg.	

2. Resulting press cake when cooked and pressed to 55 percent moisture content:

Solid matter	80 kg.	
Fat or oil	3 "	
Water	102 "	
		185 kg. = total press cake
Solids lost in stickwater	20 kg.	
Fat lost in stickwater .	2 "	
Water in stickwater . .	293 "	315 kg. = total stickwater
		500 kg.

As the oil content in the stickwater is less than 1 percent, no appreciable amount will be recovered.

Resulting meal, cooked, pressed and dried:

Solid matter	80 kg.	
Fat	3 "	
Water . . .	9 "	92 kg. = total meal
	93 "	= total water evaporated in drier
	185 kg.	

Thus, with Method 1, $117 - 92 = 25$ kg. more meal, or $\frac{25}{92} = 27$ percent higher yield is obtained and the meal dried directly also contains an appreciably higher percentage of proteins, on which the sales price is generally based. The total meal obtained by Method 1, therefore, is worth about 30 percent more than that obtained by Method 2. This might amount to about 22 to 24 shillings per 500 kg. fish.

In order to obtain this higher yield of meal, 290 kg. (383 – 93) more water must be evaporated, which will require approximately 32 kg. fuel oil, costing about 6 to 8 shillings.

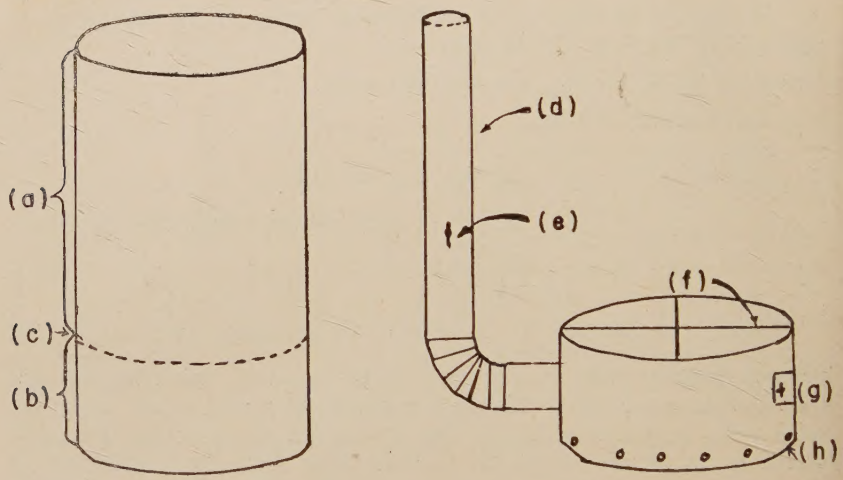
II. Methods of Processing

Now that this brief outline of the general principles has been given, the various processes can be described in more detail. Fish meal manufacture may be undertaken on a small scale by most primitive methods. Simple air or sun-drying of the minced raw material has even been practised. The raw material is distributed on the beach or on concrete floors to the height of a few centimeters, and left to dry, while being turned over many times by hand. Even in tropical countries the atmosphere can be so damp that such a process can take many days, therefore often giving very inferior products, moldy, off-colored, off-flavored, and contaminated with sand. A well-cooked and pressed raw material, with not much more than 50 percent moisture stands a much better chance. In such cases natural

drying may be adopted, but some form of artificial drying to speed up the process and produce a good grade product is still recommended.

A. Miniature Manufacture

The cooking of the fish can be carried out in pots heated directly over a fire. The United States Fish and Wildlife Service, in their *Fishery Leaflet* 135, [2] describe a very simple apparatus that is easy to make. Take a 40 to 50 gallon steel drum (140 to 175 liters) and cut off the bottom third, as shown in Figure 3. This will make the



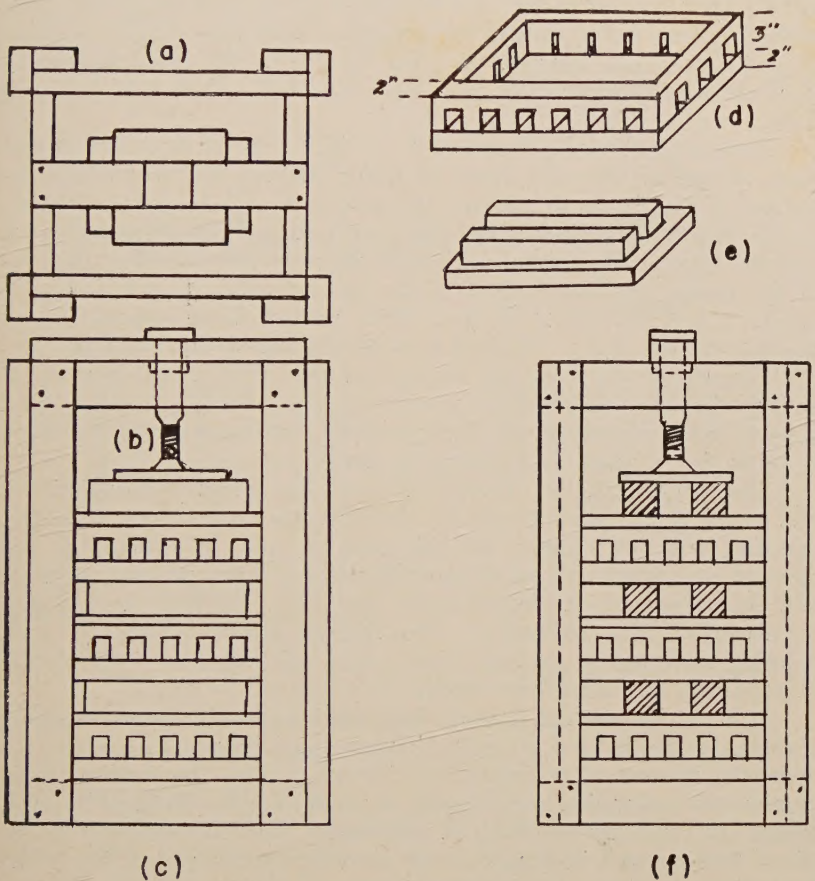
(a) Boiler (40 or 50 gal. steel drum)
(b) Heater
(c) Cut along dotted line to make heater
(d) Chimney
(e) Damper
(f) Iron crossbars
(g) Door
(h) Air holes

Figure 3. Simple equipment for cooking fish waste for meal manufacture.

heater when a chimney is added to it; cut a door for adding fuel and punch air holes round the bottom. The heater will work well with wood or charcoal. To support the boiler, place a piece of black sheet iron or two crossed, stout iron bars on top. The other two-thirds of the drum, turned upside down, will do for the boiler, and will hold about 25 to 30 gallons (94 to 113 liters). In order to cook the fish, fill the boiler to about half-full with water and bring it to a boil. Add about 75 kg. of chopped fish and cook for 20 to 25 minutes with occasional stirring. Allow to cool for 10 minutes, and draw off the surface liquid. Experience will, in every case, indicate if this cooking is sufficient for the raw material in question. The fish protein should be throughly coagulated, so that the subsequent pressing operation

[2] Anglo-American Caribbean Commission. Guide to Commercial Shark Fishing in the Caribbean Area. *Fishery Leaflet* 135. United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A., 1945. 145 pp.

gives a hard and dry press cake. In order to extract as much oil as possible from the raw material and obtain a meal with low fat content it may be advantageous to prolong the boiling. Now take the cooked material out of the boiler — a ladle of wire mesh may be useful — and place it in the press. Small presses suitable for the



(a) Top view
(b) Screw jack
(c) Front view
(d) Press box
(e) Lid
(f) Side view

Figure 4. A simple screw press for extraction of water and oil from cooked fish waste.

purpose, for instance small wine presses, should be easily obtained. *Fishery Leaflet* 135 describes, however, a construction which is reproduced here (Figure 4). The press consists of a set of boxes in which the material to be pressed is placed, and a frame in which these boxes are pressed. Make 5 or 6 boxes using wood, 1½ inches or 2 inches (4 to 6 cm.) thick. The boxes should be 3 feet × 3 feet × 3 inches (91×91×7.6 cm.) inside measurement. The lid should be reinforced,

and just fit smoothly inside the box. On the lid attach two piece of 3 × 3 inches (7.6 × 7.6 cm.) wood just a little shorter than the length of the lid — about 2 feet 10 inches (86 cm.). Through the sides and ends of the boxes, make a number of holes through which the liquid can escape as it is squeezed out. These holes should start from the bottom of the box and be 2 inches (5 cm.) high. As the sides are 3 inches (7.6 cm.) high, this will leave 1 inch (2.5 cm.) solid wood above. These holes should be wider outside than inside, so that they will not get stopped up. On the inside the holes should be $\frac{1}{4}$ of an inch (6.4 mm.) wide, and on the outside $\frac{3}{4}$ of an inch (1.9 cm.) wide.

Make a good sturdy frame of 2 × 4 inch (5 × 10 cm.) timber just large enough so that the boxes fit snugly inside. Put stops near the bottom of the frame to prevent the bottom box from going through. At the top of the frame place either an ordinary large screw-jack or a stout, long-handled lever, to give the pressure for squeezing the meal in the boxes. At the bottom of the jack attach a 3 inch (7.6 cm.) board, 2 × 2 feet (61 × 61 cm.) which pushes down squarely on to the 3 × 3 inch (7.6 × 7.6 cm.) bars on the lid of the top box.

Experience will show how the cooked mass should best be pressed. It is preferable to increase the pressure slowly, allowing the stuff good time to drain, and when the final pressure has been reached, to leave it there for at least 10 minutes to drain.

The pressing device described above is indeed very primitive, and much better results may be obtained when pressing the cooked material between cloths. In this case it may be possible to get down to a moisture content of about 35 percent in the pressed product, and the subsequent drying is made very easy ; artificial drying may be dispensed with altogether. The manual labor involved in cloth pressing is, however, greater ; then comes the expense of the cloths, in any case an insignificant item.

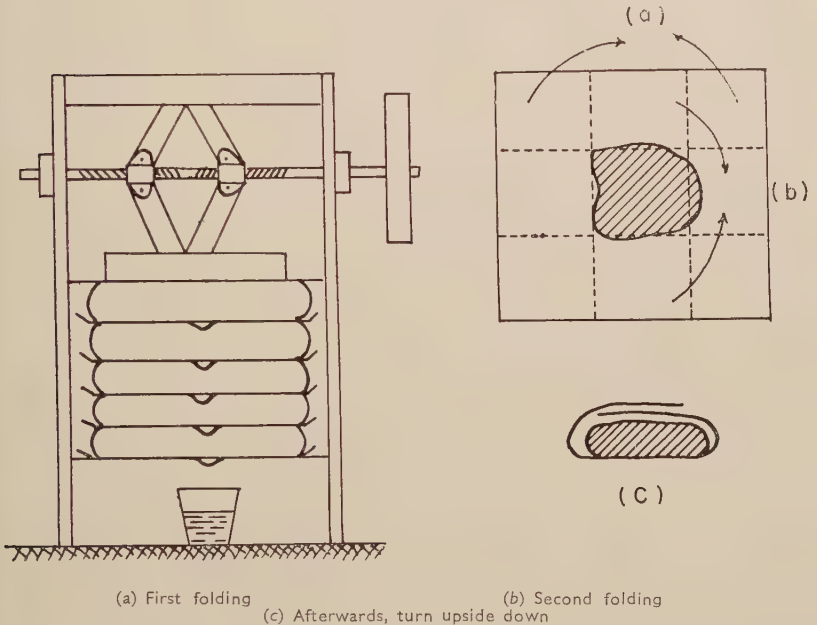
It is not intended to describe here the innumerable press constructions that might be used, from the simplest of spindle presses to elaborate hydraulic presses. The important feature is that the device allows pressure to be applied very slowly. A press to suit individual requirements can certainly be obtained anywhere. The diagrammatic sketch of a " knee-press " in Figure 5 may serve as an example. A few words about the pressing may, however, be useful.

Coarsely woven linen cloth may be used : it is strong, but inconveniently smooth. Ordinary sack cloth, jute, is excellent for most purposes. It is cheap, sufficiently strong, and has a good rough surface that bites into the slippery cooked mass. It is also easy to wash. Note that the cloths must be washed after each pressing operation, or they will clog and reduce the efficiency. 5 percent soda is a convenient washing solution.

In a small hand-driven knee press, with 16 × 24 inches (40 × 60 cm.) platens, not much more than 5 press cakes should be pressed at a time. A rough or slightly buckled iron plate, 0.04 to 0.06 inches (1 to 1½ mm.) thick, should be placed between each charge ; the plates should have

slightly lifted edges so as to form a tray with lip for the oil and water that runs away.

The correct charging of the press is very important. Place the cloth, 48 × 72 inches (1.20 × 1.80 m.) over two racks on a table close by the press, and fill the cooked, drained mass, not more than 15 to 20 kg., in the center of the cloth ; then fold twice, as indicated in the diagram. As shown, the two overlappings must both practically



(a) First folding (b) Second folding
(c) Afterwards, turn upside down

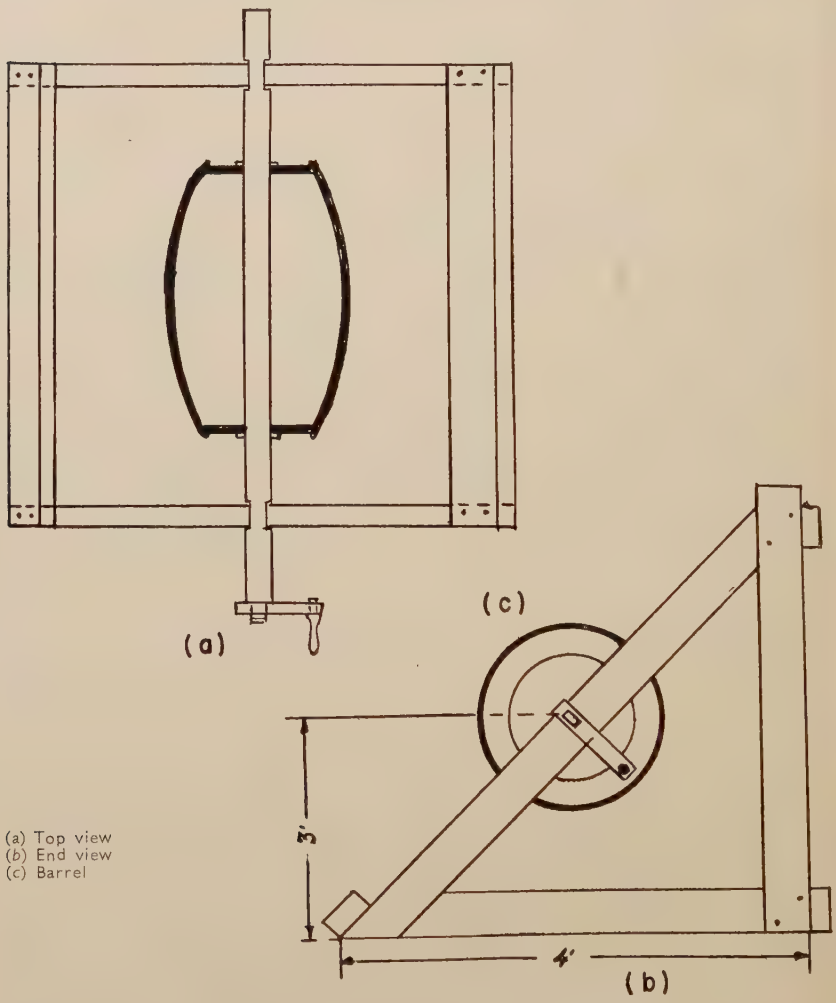
Figure 5. A simple conventional cloth press employing knee-press jack.

cover the charge. Then fold from the edges in the same way, allowing sufficient free cloth for both laps. Finally, turn the wrapped parcel upside down, and place in press. Cover with next tray, and so forth.

The pressure should be applied very slowly to begin with, not more than one-third of the total compression should take place during the first hour. The rest of the pressing should take at least 30 minutes and the charge left to drain for a sufficient length of time. Goods that are difficult to press will improve if a little salt is added. Calcium chloride, which is often recommended, must under no circumstance be used in cloth presses, as calcium soaps are formed which clog the filter cloth.

The press cake is fairly easily broken up into smaller pieces and dried on a tray placed on top of two of the heaters described in connection with the cooking. To avoid scorching, two trays should be used, one placed on top of the other, so that there is an open space of about 4 inches (10.1 cm.) between them. The lower

tray may even be half-filled with water, so as to heat the upper one with the steam. In this case it must, of course, be made water-tight, and is best made of galvanized iron, or else from a steel drum. If used as an air bath it can be made of black iron. Care must be taken not to scorch the meal. The best material for the upper tray



(a) Top view
(b) End view
(c) Barrel

Figure 6. A simple mill for grinding dried material.

is galvanized iron. The tray should be some 6 × 4 feet (1.83 × 1.22 m.) with the edges turned up about 3 inches (7.6 cm.) and be suitable for the small capacity under consideration. To get a still more uniform distribution of the heat from the two heaters, a piece of sheet iron may be placed immediately on top of them. The pressed and broken-up material is spread on the upper tray, and while being

heated it is raked about constantly to make sure that it is not being overheated. The flesh will dry faster than the bones. To avoid overheating the dry particles, they should be sifted out first by shaking through a ½ inch (1.3 cm.) sieve. Then the bones should be left to dry until they are brittle. The complete drying may require 4 to 5 hours.

The *Fishery Leaflet* mentioned also describes a primitive grinder, constructed from a barrel, which is made to rotate round a center axle (Figure 6) Several heavy, hard stones, as nearly round as possible, together with 7 to 10 kg. of the dried meal are put through a side door in the barrel. The barrel should not be filled too full. The meal will be fairly well ground in 10 to 15 minutes. The bones may require somewhat longer time.

The fish meal produced according to the method described here may be fully up to the quality produced by more elaborate methods on a bigger scale. In order to keep well, it should be dried to about 8 percent or at the most 10 percent moisture and kept absolutely dry and in as cool a place as possible. The protein content will be about 60 percent, varying with the fat content and the proportion of bones.

The hot press water should be left in a barrel for some time, when the oil will gather on the surface. It can be skimmed off, and the oil yield from several pressings may be stored hot, when more water will gradually separate to the bottom. It can then be removed through a bottom valve. The oil thus purified is of a better keeping quality.

From the above it will be realized that fish meal can very well be made — on a small scale — with the simplest of homemade equipment. The procedure given need not be followed in every detail ; it may be varied in a number of ways, which will present themselves quite naturally when these instructions are applied to individual cases. This will surely offer no difficulties, and consideration can now be given to those cases where more elaborate equipment is required. This will doubtless be necessary when, say, more than half a ton of fish per day is to be processed.

B. Small Scale Mechanized Processes

Even here the discussions will be limited to simple and cheap installations avoiding, for instance, the use of steam boilers. It is necessary though, in these cases, first to carry out a reasonably accurate cost estimate, to make sure that the capital investment is justified. From the first section of this article, together with more precise data as to the composition of the raw material, an average yield may be established. The total cost of production per day or per 100 kg. meal may be estimated on the basis of the cost of raw material, labor, fuel, etc. The equipment suggested is of such sturdy construction that it may be amortized in about 10 years.

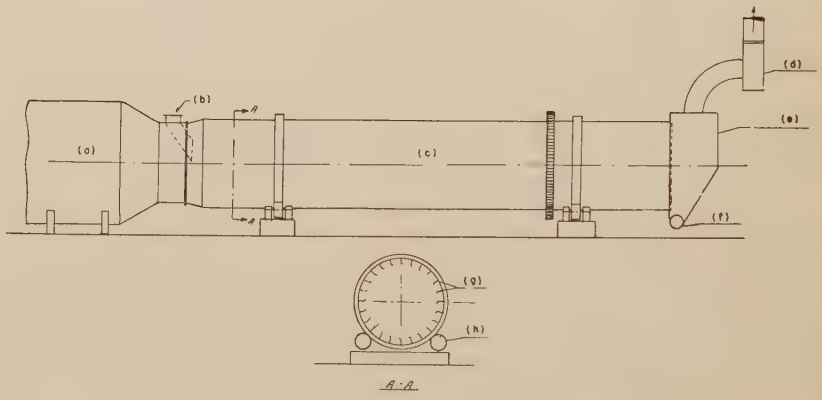
Two processes suitable for small installations will be described :

1. direct drying of lean, raw material in so-called flame driers ;
2. indirect drying of any type of raw material by fuel gases passing through rotating steel tubes.

These processes are very simple and can be adopted for different types of raw material and such plants can be constructed in capacities down to a couple of tons of raw material a day. They are well worth studying by anyone who has a fairly regular supply of fish available.

1. *Direct Drying of Raw Material to Fish Meal*

(a) *Simple direct drying.* The raw fish are macerated in a disintegrator and passed to a so-called flame drier. This consists of a steel cylinder (Figure 7) mounted on trunnions, given a slow rotation. Inside the cylinder, longitudinal flights lift the material and allow it to fall through the path of the hot gases passing through the drier concurrently with the meal. After leaving the drier, the meal is ground, cooled and sacked, thus completing the process.



(a) Furnace
(b) Feed inlet
(c) Drier
(d) Exhaust fan
(e) Dust chamber
(f) Meal discharge
(g) Lifting ribs
(h) Trunnion

Figure 7. A direct flame drier for drying fish waste without preliminary cooking or pressing.

This method can be used for most non-fatty fish, provided the drier-furnace is capable of withstanding high temperatures, as the difficulties due to the gluey nature of the water released upon heating is greatly reduced when operating at high inlet temperatures.

Due to the relatively simple plants involved, this method should be given careful consideration in all cases where non-fatty fish are to be processed into fish meal. Such plants are widely used for utilizing fresh fish and offal from freezing plants, salteries, etc.

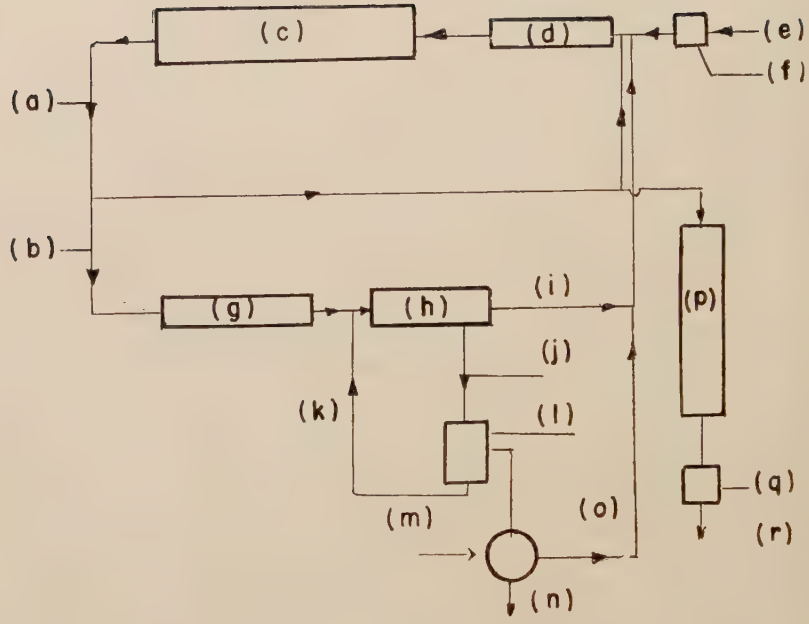
(b) *Direct drying, using recirculation.* The process described below is a refinement of the simple method described above and was

originally developed and patented by O. Notevarp at the Norwegian Fisheries Research Institute. In certain cases the crude material, upon being heated, coagulates, thereby setting free great amounts of water. This water contains much gluey matter, which causes the material to stick and cake together, forming lumps, adhering to the heating surface, and interfering in every way with an efficient drying. When preliminary pressing takes place, so much glue is removed that the drying may be carried out without inconvenience. However, pressing is just the complication to be avoided. The Notevarp process, therefore, consists in mixing the finely divided raw material with dried or partly dried material in such a proportion that the mixture forms a semi-dry product which can be dried without any inconvenience. The process can be carried out in a flame drier as described above. Besides the drier cylinder proper and the furnace for producing the hot gases, an efficient blending device is needed. Here the minced fish is mixed intimately with part of the dry stuff. The proportion varies according to the system adopted. As it is often an advantage to dry in two steps (i.e. two driers placed in series) when dealing with greater amounts of raw material, the semi-dry material from the first drier, with, say, 30 percent moisture, is circulated. In this case a high percentage of dry goods admixture is needed. If, for instance, the original raw material holds 80 percent moisture, an amount of recirculated material equal to 1½ times the weight of raw material is required to obtain a mixture with about 50 percent moisture. For some raw material it will be found necessary to use a much higher proportion of admixed product. As calculations show, further addition will alter the moisture less drastically, a proportion of 1 : 5 still giving a mixture with 38 percent water. Such a mixture can, however, be dried in the flame drier very easily.

A further simplification may result through eliminating the second drier, if climatic conditions are favorable to air drying. It is, of course, much easier to dry a product with a moisture content of only 30 to 40 percent, where most of the water has already been removed. A few hours exposure to dry air will immediately remove the goods from the zone where quick putrefaction threatens, and the final drying can be accomplished without detriment to the meal. Such drying is specially effective if the first drying has been conducted in such a way that the protein substance has been coagulated.

Figure 8 shows, diagrammatically, an installation for handling 10 tons of raw material per 8 hours. The total cost of such an installation might amount to some £5,000 to £6,000 ex. European port. The biggest items are the drier proper, 39 feet 4 inches long × 5 feet 3 inches wide (12 × 1.6 m.) and the furnace, with burners, fans, etc.

When working with fatty raw material it may be of advantage to subject the warm semi-dry mass to a pressing operation before completing the drying. This will yield a less fatty meal but will, on the other hand, give rise to losses of solids with the press liquid. In any case it is preferable, if the material needs pressing, to adopt the next method to be described.



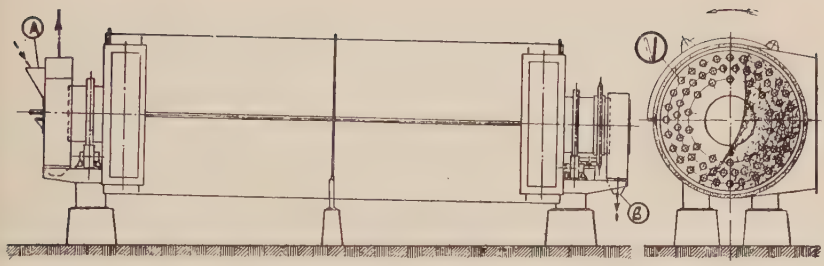
(a) Partly dried material
(b) For fatty raw material
(c) Drier I
(d) Mixer
(e) Raw material
(f) Hacking machine
(g) Pre-heater
(h) Press
(i) Press cake
(j) Press liquid
(k) Foot
(l) Screen
(m) Separator
(n) Oil
(o) Stickwater
(p) Drier II
(q) Mill
(r) Meal

Figure 8. Flow sheet for fish meal manufacturing process adding an admixture of a certain percentage of partly dried meal to the raw material to facilitate the drying process.

2. *Indirect Cooking/Drying of Fresh Raw Material*

The second general method, which is particularly recommended, is specially suitable for oily fish, and consists in an indirect cooking and drying of the raw material with flue gases. This process obviates the recirculation of the material, as the lumping and clogging is effectively avoided. The apparatus required is illustrated in Figure 9 and has been developed in Scandinavia by the Swedish inventor G. Bojner.

The flue gases are conducted through a set of horizontal iron tubes which rotate in the charge. This is being filled into the drier continuously at one end and discharged at the other. As in the previous method no steam boiler is required for the cooker/drier, and the heating surface is constructed very simply and cheaply, as no high-pressure steam is involved. The transfer of heat from the flue gases through the metal tubes is less intense than is the case with condensing steam inside the tubes, and thus no coating on the tubes



A — Goods inlet B — Goods outlet

Figure 9. Tubular flue-gas cooker/drier.

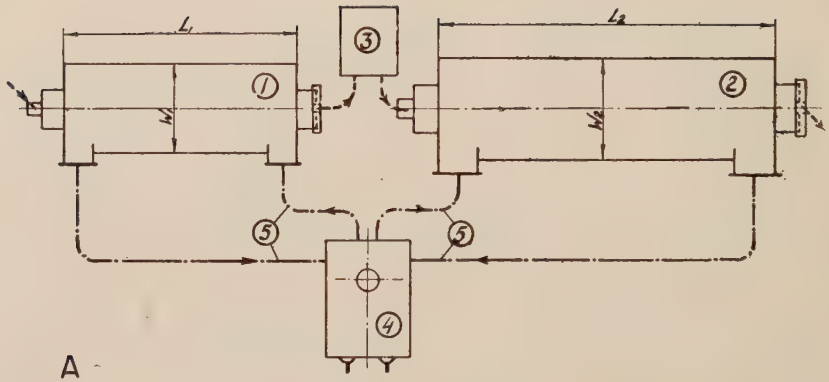
occurs. The conducting of these flue gases through the tubes inevitably results in soot on the inside of the tubes, and the heat transfer is soon seriously impaired. This is corrected by the ingenious device of putting a tumbling flat iron bar inside each tube. This arrangement, which need not be described in detail, works very efficiently and thus insures the necessary heat transfer.

It is possible to dry the material in one operation without previous pressing and oil separation, but it is preferable to conduct the process in two stages, cooking and drying. In this way an excellent heat economy is achieved.

A complete installation then consists of two aggregates, which we shall term *cooker* and *drier* respectively. The raw material entering the cooker need not be previously minced as it is effectively ground and blended by the rotating set of tubes. At the outlet end of the cooker, the mass has attained a temperature of 194° to 203° F. (90° to 95° C.), the protein is thoroughly coagulated, and it can be pressed either in continuous screw or in hydraulic presses, and the moisture content can be brought well below 50 percent.

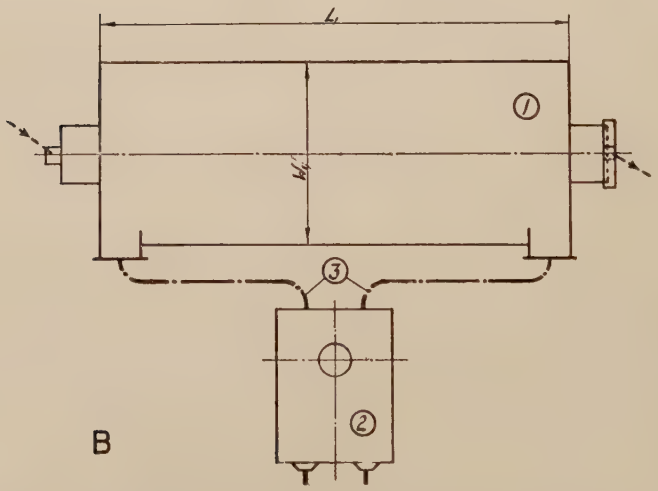
It is of great importance to understand the difference in heat consumption between a process "A" in which water is partly pressed away from the cooked material, afterwards dried, and a process "B" in which the total elimination of water is carried out in one cooking/drying unit. The following figures show the quantity of water which has to be evaporated or separated from the raw material to obtain 100 kg. of meal with a moisture content of about 10 percent.

Original Moisture Content	Water to be Removed to Obtain Meal
Percent	*Kilograms*
76	275.0
74	246.0
72	221.0
70	200.0
60	125.0
56	104.5
54	95.5
52	87.5
50	80.5



Process A. (1) Cooker, (2) Drier, (3) Separating devices, (4) Furnace, (5) Gas circulating ducts
L_1 = circ. 3.7 m. L_2 = circ. 5.2 m.
W_1 = circ. 1.5 m. W_2 = circ. 1.7 m.

Fuel oil consumption: 80 kg./hour
Price for cooker and drier f.o.b. Swedish port: c. £ 7,000



Process B. (1) Cooker/drier, one unit, (2) Furnace, (3) Gas circulating ducts.
L_1 = circ. 7.3 m. W_1 = circ. 3.0 m.

Fuel oil consumption: 180 kg./hour
Price for cooker/drier f.o.b. Swedish port: c. £ 12,500

Figure 10. Fish drying plants for handling 25 tons of raw material per 8 hours each.

By drying a crude product containing, for instance, 74 percent moisture, one needs to remove, by evaporation, 2.8 times as much water as would be the case when starting with a press cake with 52 percent moisture. On the other hand, what was explained in the first part of this article about losses of solid matter with the press water must be borne in mind. Where supply of raw material is abundant and fuel expensive, it may be wise to include a pressing operation. This would be unavoidable in dealing with fatty raw material. Where the cooked material is pressed it is of course necessary to separate the oil from the press water. Centrifuges are not absolutely necessary. Before their advent, the oil separation in the factories took place in settling tanks. Such tanks may often be the best solution when the economy does not justify the use of centrifuges.

In the process " B ", on the other hand, all the fat will be left in the dried material. Such a process is, therefore, only suitable for non-fatty raw material, and it must be remembered that a much greater heating surface is required for the same amount of raw material.

Two installations, one for 25 tons per 8 hours of oily fish according to process " A " (combination of cooker and drier with intermediary press) and the other for the same amount of lean fish according to process " B " in one big machine, are shown diagrammatically in Figure 10.

The cost of installation for this capacity would be about £7,000 or £13,500 ex. European port for the two processes " A " and " B " respectively. For 10 tons capacity, the prices are correspondingly smaller, about £4,000 and £8,000. The drier can even be constructed with one or two ton capacity per 8 hours, built for heating with wood. Such a drier is illustrated in Figure 1. The price for such a small installation would be about £500 to £600.

In dealing with the manufacture of fish meal on a semi-industrial scale according to the processes of direct or indirect heating, alternatives " A " and " B ", we have been much more vague than when describing the " domestic " miniature process. This is very understandable as numbers of factors must be considered before the correct method, and the most suitable details may be decided upon. It is hoped, however, that this exposé may assist prospective manufacturers in forming a clear notion of the possibilities.

T. Sparre

ACID PRESERVATION OF FISH AND FISH OFFAL[1]

In connection with the above article on inexpensive methods for the manufacture of fish meal, it may be useful to call attention to the various methods for the manufacture of fish silage which require little special equipment and are very inexpensive. The product is well suited for the feeding of poultry, swine, etc., and has gained general acceptance in recent years.

I. Introduction

In the 1920's, A.I. Virtanen invented a method for preservation of green fodder. The principle of the method is to acidify crops by means of one or more strong inorganic acids. In 1936, attempts were started in Sweden with the A.I. Virtanen (A.I.V.) process for preservation of fish and fish offal intended for use as animal feed ; the results of the experiments have been published in works of Edin (1940) and Olsson (1942). The Swedish experiments included, besides the A.I.V. process, two other acid preservation methods : the Sulphuric Acid/ Molasses Method and the Formic Acid Method.

The procedure is so far mainly confined to the Scandinavian countries, although interest in it is developing elsewhere and there is already a small scale industry established in Britain (*see* Hanson and Lovern, 1951). Petersen (1951) has given a survey of the development in Denmark, where production was started in 1948 and now amounts to about 15 million kg. annually. The above Swedish methods have formed the basis for the production, which by degrees have been somewhat altered to improve the quality and reduce costs. As an interesting stage in the development it must be mentioned that Carl (1952) has invented a special method of fermentation.

II. Pretreatment

To ensure a satisfactory silage, the first condition is that the fish must be absolutely fresh. To obtain an effective preservation of the raw material and to avoid unnecessary large quantities of preservaties, the fish must be minced sufficiently before being mixed with the preservatives. In Denmark, ordinary meat grinding mills are used in many small plants, while the bigger ones, as a rule, use specially built machines.

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[1] By Halvor Petersen, Technological Laboratory, Ministry of Fisheries, Copenhagen, Denmark.

III. Sulphuric Acid Silage (Semi-finished Product)

To ensure satisfactory keeping qualities with sulphuric acid alone it has been found necessary to acidify to a pH value of about 2. The high degree of acidity necessitates that the sulphuric acid silage be partly neutralized before use. The neutralization must be done by the farmer at each time of feeding, since the neutralized product will not keep. The farmer regards the neutralization as being troublesome, and the development has, therefore, pointed in the direction of producing non-perishable products of fish silage to be used without any neutralization. Sulphuric acid silage is still of great importance as a semi-finished product when producing one of these products. The acidifying is done at a fishing harbor in Jutland, where absolutely fresh fish are present in sufficient quantities. The storage takes place in large vessels of concrete, painted internally with bitumen. The sulphuric acid silage is gradually sent to a series of centers which prepare it for final distribution (*see* Sulphuric Acid/Formic Acid Silage, Method 1, p. 22).

Acid used. Edin (1940) used A.I.V. acid (hydrochloric acid +sulphuric acid, 14 N). In Denmark, it is recommended that A.I.V. acid be replaced by sulphuric acid free of arsenic (50% i.e. 14 N), which possesses the same preserving qualities, but is pure.

Quantity of acid. For calculation of the quantity of sulphuric acid (50%) necessary to adjust the pH to 2 the following formula is used (Edin, 1940): $0.14 \times$ % crude protein $+ 0.9 \times$ % ash = liters sulphuric acid (50%) per 100 kg. raw material.

Example 1. Herring: 17.2% crude protein, 2.4% ash.
$0.14 \times 17.2 + 0.9 \times 2.4 = 4.6$ liters sulphuric acid (50%) per 100 kg. herring.

Example 2. Cod backbone: 16.9% crude protein, 5.0% ash.
$0.14 \times 16.9 + 0.9 \times 5.0 = 6.9$ liters sulphuric acid (50%) per 100 kg. cod backbone.

Petersen (unpublished) has found that the quantities of sulphuric acid calculated by Edin's formula will give pH 1.5 to 1.8 when an equilibrium between fish and sulphuric acid has set in. This will occur after 24 to 48 hours of proper grinding and mixing. Immediately after acidifying, the pH of the fish silage is somewhat less.

In practice, there is no time to wait for the result of an analysis before the sulphuric acid is added. Instead of this one calculates, by means of Edin's formula and on the basis of the maximum contents of crude protein and ash in the type of raw material concerned, how much sulphuric acid is necessary to ensure preservation under all circumstances. As a further precaution, in the summer months 10 percent additional sulphuric acid is added. According to these principles Olsson (1942) set up the figures for Scandinavian raw materials as given in Table 1.

TABLE 1 — QUANTITY OF SULPHURIC ACID (50%) REQUIRED FOR HERRING, SPRAT, CODLING, AND COD FILLET WASTE AT VARIOUS TIMES OF THE YEAR

Raw Material	October/April	May/September
	Liters per 100 kilograms	
Herring	5.0	5.5
Sprat	5.5	6.0
Codling	5.5	6.0
Cod fillet waste	8.0	9.0

When the equilibrium between raw material and sulphuric acid has set in, the pH of the silage must be tested. If the pH is higher than 2, more sulphuric acid has to be added, so that the pH can be reduced to 2. This is calculated with another formula of Edin's (1940):

$s = 0.3 \times S \times (pH - 2)$, where

s = liters of sulphuric acid (50%) being added per 100 kg. fish silage;

S = liters of sulphuric acid (50%) added originally per 100 kg. raw material, and where pH = pH value, found on testing.

Example 3. If originally 5.5 liters of sulphuric acid (50%) per 100 kg. raw material were used and produced a pH value of 2.8 instead of 2, then $s = 0.3 \times 5.5 \times (2.8 - 2) = 1.3$, which means that 1.3 liters sulphuric acid (50%) must be mixed with 100 kg. fish silage.

Edin states that *s* is an approximate value and that the formula is only valid at relatively low pH values. Experiments carried out by Petersen (unpublished) have confirmed that the formula has an approximate validity for pH values under 3.

Acidifying. When mixing minced fish with sulphuric acid, only tools and vats resisting the action of the acid may be used. Wooden shovels and concrete vats coated with bitumen are usable. In Denmark, some mechanical apparatus has been invented which secures a careful mincing of the fish and at the same time an effective mixing of the fish with sulphuric acid. If there is no such special apparatus available the mixing can be done in batches by hand, mixing, for instance 10 kg. minced fish at a time. In the latter case it is necessary to stir the fish silage thoroughly once daily for about a week.

Neutralization. Sulphuric acid silage is sent to the farmer as an unfinished product, which must, as mentioned previously, be partly neutralized before feeding. Olsson (1942) calculates that normally an addition of 37 g. chalk per kilogram silage will bring the pH to about 4, and states that the silage can be used as feed about 3 hours after the addition of chalk. Petersen (unpublished) has found that the quantity of chalk ranges from 20 to 50 g. per kilogram silage (*see* Table 2).

TABLE 2 — GRAMS OF CHALK REQUIRED TO NEUTRALIZE 1 KG. SILAGE TO A pH OF 4

Raw Material	pH of the Silage	
	2.0	1.0
	Grams	
Herring	20	30
Cod backbone	30	50

The partly neutralized silage has a keeping quality of not more than 48 hours. The further treatment of partly neutralized sulphuric acid silage to obtain a non-perishable product is mentioned in the section "Sulphuric Acid/Formic Acid Silage," Method 1.

IV. Formic Acid Silage (Finished Product)

Fish acidified with formic acid alone are, contrary to sulphuric acid silage, of a good keeping quality, even if the formic acid has been added in such a quantity that the pH has been lowered to only 4.5. In other words the formic acid silage is a non-perishable product, which can be used without any neutralization.

Acid used. Olsson (1942) used 90% formic acid (23.5 N) in his experiments. In Denmark, 85% formic acid (22 N) is used. One liter of formic acid (90%) corresponds to 1.07 liters of formic acid (85%).

Quantity of acid. Olsson (1942) recommends that the necessary quantity of formic acid (90%) be calculated according to the formulae:

$0.25 + 0.3 \times$ % ash = liters formic acid (90 %) per 100 kg. raw material in winter.

$0.50 + 0.3 \times$ % ash = liters formic acid (90 %) per 100 kg. raw material in summer.

Example 1. Herring: 2.4% ash.

$0.25 + 0.3 \times 2.4 = 1.0$ liter formic acid (90%) = 1.1 liters formic acid (85%) per 100 kg. herring in winter.

$0.50 + 0.3 \times 2.4 = 1.2$ liters formic acid (90%) = 1.3 liters formic acid (85%) per 100 kg. herring in summer.

Example 2. Cod backbone: 5.0% ash.

$0.25 + 0.3 \times 5.0 = 1.8$ liters formic acid (90 %) = 1.9 liters formic acid (85%) per 100 kg. cod backbone in winter.

$0.50 + 0.3 \times 5.0 = 2.0$ liters formic acid (90 %) = 2.1 liters formic acid (85%) per 100 kg. cod backbone in summer.

Experiments carried out by Petersen (unpublished) have confirmed the validity of the formulae.

On the basis of Olsson's formulae and the maximum contents of ash for the type of fish concerned it is possible to calculate the quantity of formic acid required to ensure preservation.

Acidifying. The mixing of minced fish with formic acid must be carried out very carefully. If it is done by hand the method described under "Sulphuric Acid Silage (Acidifying)" must be used.

V. Sulphuric Acid/Formic Acid Silage (Finished product)

Sulphuric acid/formic acid silage can be produced in two ways :

1. sulphuric acid silage (pH 2) is partly neutralized to pH about 4 and formic acid (85%) added ;
2. raw material is mixed with sulphuric acid (50%) + formic acid (85%).

The advantage of combining sulphuric and formic acid ensiling is, partly, that a product is obtained which need not be neutralized before use (as does pure sulphuric acid silage) and partly, that a product is obtained with Method 2 which is cheaper to produce than pure formic acid silage because it is possible to reduce the quantity of formic acid required. In Denmark, the price of one liter of formic acid (85%) is about 8 times higher than the price of 1 liter of sulphuric acid free of arsenic (50%).

Method 1. When using this method, the further treatment of the semi-finished product, described under "Sulphuric Acid Silage" is required. Sulphuric acid silage is neutralized to pH about 4. To ensure that the partly neutralized silage will keep, it is mixed with 1% formic acid (85%). In this way the pH is reduced to about 3.5 and the silage can be used as feed without any previous neutralization.

Method 2. When using this method, which has been tested on codling by Petersen (unpublished), the hard pre-acidifying with sulphuric acid and the following neutralization are omitted. Instead, the minced codling is immediately mixed with a smaller amount of sulphuric acid (50%) + formic acid (85%). When using 2 liters sulphuric acid (50%) per 100 kg. codling, in summer, it will be sufficient to use 0.8 liter formic acid (50%) or half as much formic acid as that calculated according to Olsson's formula. By this, the pH is reduced to 3.7, but will increase in a few days to 4.3 where it will remain constant for a long time.

VI. Sulphuric Acid/Molasses Silage (Finished Product)

One hundred parts fish mixed carefully with 20 parts molasses will, according to Edin (1940), ferment in a few days, and the volume will be increased by about 50 percent. Gradually, the fermentation will cease, the mixture will return to its original volume and keep for a long time However, it appears that the great increase in volume during fermentation can be inhibited by the addition of acid, using the following mixture : 100 kg. fish + 2 liters sulphuric acid (50%) + 20 kg. molasses. This method of preservation is not only based on a lowering of the pH of the fish, but also on the addition of sugar and salts in the molasses. This combination lowers the pH to about 4.5 in the finished product which, with this combination of acids, is sufficient to make it usable as feed without any prior neutralization.

In hot weather the sulphuric acid/molasses silage sometimes ferments rather quickly. Petersen (unpublished) has shown that fermentation can be inhibited to some extent by adding sodium benzoate to the silage in a quantity corresponding to 0.2% benzoic acid.

VII. Fermentation Silage (Finished Product)

As mentioned in the introduction, Carl (1952) has invented the following method of fermentation, and applied for a patent on it. 80 kg. minced fish are mixed with 15 kg. molasses and a culture of the lactic acid bacterium *S. plantarum* added, resulting in a pH value of 3 to 4 in 3 to 4 days. The product has a good keeping quality and no unpleasant fish odor; it need not be neutralized before use.

Experiments carried out by Riemann (unpublished) have confirmed that a good fermentation silage can be produced with *S. plantarum*, without risk of mold and yeast infection during fermentation, provided that:

1. the mixture of fish and molasses be acidified to a pH of about 6, before the inoculation;
2. the inoculated silage is incubated at about 86° F. (30° C.);
3. the supply of air is sufficient, during the fermentation, so that a dry crust is formed on the surface of the silage.

The pre-acidifying is not mentioned in the patent, but from the labels on the containers with fermentation silage, it appears that an addition of acid takes place.

This method, compared with other methods of ensiling, seems to be rather complicated. In feeding experiments carried out by the Danish National Research Institute on Animal Husbandry, the fermentation silage does not seem to be superior to other products of silage.

VIII. Packing

As fish silage is a wet – often an almost liquid – mixture it is necessary to pack it in waterproof containers. Generally wooden barrels, plywood tubs or metal drums, painted internally with bitumen, are used. To prevent the growth of mold, the containers must be filled up and closed tightly. In this way the contents are not in contact with the air.

IX. Utilization of Fish Silage

Fish silage is, like other feed of fish origin, very valuable as a source of protein and vitamins. 1 kg. of fish silage generally gives the same quantity of protein as about 4 kg. of skimmed milk. In a country like Denmark, which lives mainly by exporting agricultural products of a high quality, it is, however, important that the feed should not

exert any unfavorable influence on the quality of the animal product. In other countries, directions less severe than the following, observed in Denmark, might be sufficient.

Poultry. For laying hens, up to 20 g. fish silage per bird can be used daily ; for breeding birds, up to 30 g. per bird daily. Table birds ought not to be fed with fish silage during the last 3 weeks before slaughtering.

Week-old chicks can take a supplement of fish silage of 50 g per 100 chicks daily. Afterwards, the supplement can be increased gradually, so that it reaches 500 g. per 100 chicks daily at the age of 5 weeks, and 850 g. per 100 chicks daily at the age of 10 weeks.

For ducks, fish silage can be used for about 10 percent of the whole diet.

Pigs. Pregnant sows can be given ½ to ¾ kg. fish silage per sow daily. Suckling sows ½ kg. per sow daily.

Weaned pigs, at the age of 7 to 8 weeks, may get 50 g. fish silage per pig daily. Afterwards, the supplement can be increased gradually so that it reaches 150 g. per pig daily at the age of 10 to 12 weeks. If the pigs are to be used for bacon, any feeding of fish silage should cease when the animals reach a weight of about 30 kg.

The Danish National Research Institute on Animal Husbandry (Denmark, Landbokonomish Forsøgslaboratorium, 1952) carried out an experiment with pigs, in which milk was substituted by fish meal or fish silage (made from the same raw material — herring with a content of 1.7% fat) in the weight-period of 30 to 50 kg. In the period when the pigs weighed 50 to 90 kg., they received the normal quantity of milk. In the experiment, 4 different sorts of fish silage were tested :

1. formic acid,
2. sulphuric acid/formic acid (Method 1),
3. sulphuric acid/molasses,
4. fermentation.

In accordance with earlier experiments the results of the above experiment proved that feed of fish origin has at least the same value as skimmed milk as a source of protein, but examinations of the quality of the bacon further proved – also in accordance with earlier experiments – that the fish silage, no matter what preservative was employed, cannot be used until the pigs reach a weight of 50 kg. without causing an essential deterioration of the flavor and keeping quality of the bacon. To be on the safe side the use of fish silage should be limited to pigs under 30 kg.

Cattle. For milk cows 1 kg. fish silage per cow can be used daily. For young cattle ½ kg. per animal daily.

Storage. The fish silage must be stored in a place where the temperature does not exceed 15° C. (59° F.). The silage must have a fresh acid odor.

X. Possibilities for Production in other Countries

If it has been economically possible to produce fish silage in Denmark, the explanation must, undoubtedly, be the following:

1. distances from the fishing harbors to the farms are short enough to make it pay to transport the silage containing all the water originally in the fish,
2. the temperature, especially in winter when the greatest consumption takes place, is low enough so that the fish silage can be kept without artificial refrigerating,
3. ensiling plants have been established in places where the supply of raw material is so small that it does not pay to produce fish meal.

In case production should be taken up in other countries, it is important to consider fully whether the necessary conditions are present. In a country with primitive communications and tropical climate it might, provided there are considerable supplies of raw material, be more natural to choose fish meal production, because meal is considerably cheaper to transport and keeps better at a high storage temperature.

Halvor Petersen

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FISHERIES OF THE INDO-PACIFIC REGION, 1951/52[1]

There has been a quickening interest in the fisheries industries of the Indo-Pacific region during the last few years. The operatives have become extremely active in effecting a change in their methods and organization, and in consequence important developments have taken place in mechanization of fishing and in the formation of fishermen's associations. National and international programs have contributed substantially towards this development ; this has included the provision of equipment, funds and personnel for the industry and for governmental research, as well as various projects in technical instruction. These are good reasons, therefore, for continuing to be optimistic about the future of these industries.

I. Resources

(*a*) Inland Fisheries

Data gathered by the fish culture sub-committee of the Indo-Pacific Fisheries Council (*see* Table 1) show that the area of inland waters is in excess of 36 million hectares and forms at least 5 percent of the total area of the countries for which there are estimates. These estimates include fish ponds, natural lakes, artificial lakes, etc., both fresh and brackish waters, but exclude the river systems and other waterways with moving water. The fish production potential of these waters is of two kinds : that which is obtained by simple capture of wild stocks of fish and that which is to be obtained by fish culture practices. The first kind of yield can be increased by stocking and in some cases by conservational practices. The second type depends entirely upon human activity. The capture of wild stocks takes place almost wherever such stocks occur, and there is no doubt that very great quantities of fish are taken by subsistence operations. Most notable of these are the lakes of Silhyet, India, the Great Lakes of Cambodia, and the lake systems of China. In addition, important commercial operations take place in the natural waterways of the great river systems and in some cases in artificially impounded bodies of water such as Mettur in southern India. There are no important instances of artificial stocking of open waterways, but the stocking of irrigation areas, more especially with paddy conservation, is rapidly developing as standard practice in the region. It is impossible at this stage to attempt an estimate of potential

[1] Based on "Status of the Fishery Industries of the Indo-Pacific Region during the Period 1951/52," presented at the fourth meeting of the Indo-Pacific Fisheries Council at Quezon City, Philippines, and published in Section I of the proceedings of that meeting.

TABLE 1 - AREA OF INLAND WATERS (CULTIVABLE) IN THE INDO-PACIFIC REGION

Country	Fish Ponds		Natural Lakes	Artificial Lakes, Reservoirs, Tanks, Channels etc.	Salt or Mangrove Marshes Suitable for Pond Construction	Lagoons and Estuarine Waters Suitable for Fish Culture	Rice Fields		Total Inland Water	Arable Land	Total Area of Country	Percentage of Cultivable Inland Water to Total Area of Country
	Fresh water	Brackish water					Without fish culture	With fish culture				
	Hectares											
British Borneo	...	...	...	50	195 000	...	17 500	...	212 550	...	19 100 000	1.1
Burma	...	...	...	...	...	...	...	...	...	8 754 000	...	...
Cambodia	120 000	...	350 000	500	...	72 000	1 400 000	...	...	...	...	...
Ceylon	...	...	...	8 000	...	117 000	350 000	...	547 000	1 469 000	6 600 000	8.3
Formosa	10 318	112 921	1 500	10 000	...	...	528 879	...	...	...	...	...
Hawaii	...	850	...	...	...	...	...	...	...	...	...	...
Hong Kong	130	60	...	214	1 200	5 700	8 280	...	15 584	...	100 000	15.8
India	337 980	2 671	725 783	179 943	121 166	264 444	5 762 792	1 619	7 396 398	123 820 000	316 100 000	2.3
Indonesia	9 000	110 000	335 000	27 000	6 000 000	8 500 000	4 500 000	67 000	19 548 000	11 000 000	149 200 000	13.1
Japan	617	...	21 000	...	...	...	495 000	18 200	534 817	5 992 000	38 200 000	1.4
Korea (South)	...	...	...	...	...	...	...	...	...	2 649 000	...	...
Malaya	150	...	...	500	300 000	...	...	300 000	600 650	2 129 000	13 530 000	4.4
New Guinea (Aus.)	...	...	80 000	...	500 000	100 000	...	...	...	...	...	...
Pakistan	105 000	25 100	30 100	68 500	305 200	424 000	8 215 400	...	8 749 300	21 000 000	94 300 000	9.3
Philippines	50	70 000	199 400	437	430 400	...	516 000	...	1 146 287	8 180 000	29 600 000	3.9
Singapore	...	253	...	...	...	...	...	...	253	...	70 000	0.4
Thailand	100	...	25 700	...	...	...	6 161 000	...	6 186 800	4 751 000	50 000 000	0.1

productivity of inland waters. The productivity of cultivated waters is generally much greater than that of open waterways ; if the modest figure of one ton per hectare could be expected, fish ponds of the area, which amount to half-a-million hectares, should be able to produce half-a-million tons of fish.

The extent of brackish-water in the region is very considerable. These waters carry natural stocks and can support culture operations, particularly the cultivation of Chanos chanos, mullets and shrimps, which takes place principally in India, Indonesia and the Philippines.

(*b*) Marine Fisheries

In considering the marine resources, it is desirable to attempt a division of the region into a series of sub-areas or provinces, as follows :

1. The *Arabian Sea* undoubtedly contains pelagic resources, but little is yet known about them and there is virtually no fishery. The fisheries of the Laccadive and Maldive Islands are an exception to this.
2. The *Indo-Pakistan* continental shelf carries both demersal and pelagic resources which are at present subject to fishing operations. There is every reason to believe that the yield from the demersal resources could be greatly increased especially from the Kathiawar coast and Wadge Bank. The pelagic resources, which include Rastrelliger and the Indian oil sardine, are subject to considerable exploitation. It is possible that extensive exploration and research might stabilize and sometimes increase the catch of these species ; the main problem is probably to improve the knowledge of the behavior of these fishes. There is an extensive littoral stock, of which the coast of Ceylon may conveniently be considered a part. This stock is subject to continuous fishing. The possibility of mid-water stock, either as permanent inhabitants or as transients from the demersal or the pelagic, has not yet been explored.
3. The *Bay of Bengal* has known littoral resources which are extensively fished and demersal stocks whose limits outward from the coast are as yet undefined. Undoubtedly, there are also pelagic and perhaps mid-water resources.
4. The *Andaman Sea* contains extensive demersal stocks as inhabitants of the reefs of the Andaman and Nicobar Islands and of the Mergui Archipelago. Undoubtedly there are pelagic stocks.
5. The *Straits of Malacca* carries littoral stocks, and in offshore water both pelagic (Rastrelliger) and demersal stocks, all of which are subject to relatively intense fishing.
6. The *Indian Ocean* is known to contain pelagic resources (including tuna), but they are not subject to fishing.

7. The *Gulf of Thailand and the Southern South China Sea* contain littoral stocks which are subject to very intense fishing, especially in the Gulf of Thailand. Demersal stocks are known to be present in the offshore waters but are not exploited to any great extent. Pelagic resources are known to exist.
8. *Gulf of Tonking and the Northern South China Sea.* The littoral stocks, offshore demersal stocks in the Gulf of Tonking and off the China coast, and pelagic stocks, at least off the China coast, are fished intensively.
9. The *East China Sea and Yellow Sea* carry very considerable stocks of fish in all strata and constitute one of the most intensively fished provinces of the region. The littoral fisheries are very intense.
10. The *Sea of Japan* is also extremely rich in littoral and offshore stocks and is very intensively fished.
11. The *Western Sunda Seas* carry rich littoral stocks and extensive areas with demersal stocks in offshore waters (chiefly reef fish) ; there are also considerable pelagic stocks.
12. The *Eastern Sunda Seas*, besides the littoral stocks and demersal stocks which are essentially reef fish, carry heavy stocks of pelagic offshore fishes, including the flying fish and tuna. The former are subject to intensive fishing.
13. The *Pacific Ocean* carries abundant littoral stocks in the reefs and lagoons of islands and undoubtedly carries an abundance of oceanic pelagic fishes. The fisheries are relatively neglected.
14. *Australia.* A sub-division of this province into tropical and temperate sections will be necessary. The tropical section carries littoral stocks and reef and pelagic stocks offshore. The fisheries are not greatly developed. The temperate section carries littoral stocks which are intensively fished in the east, south-east and south-west. There are demersal stocks on the continental shelf and pelagic neritic stocks.

II. Fisheries Industries

(*a*) Fishing Operations

The most striking feature of the marine fishing industries of the region is the vigor with which mechanization is being effected. It is probably true that some development of this kind is taking place in every country of the region by the action of the fishermen themselves. Sometimes the change involves the installation of an engine in an existing craft, in other cases the building of new craft. Notable instances of such vigorous development are those of Bombay Province, Malaya, Singapore and Hong Kong. This move is being

assisted in various ways by governments, as those of Bombay, Singapore and Hong Kong. Coupled with the action of the fishermen are projects receiving external aid under technical assistance programs. Thus, the Government of Indonesia has received a substantial contribution of vessels and engines from the United States under the Mutual Security Agency and it is understood that a similar contribution will be received by the Government of India. Again, FAO and the Colombo Plan have been assisting the Government of Ceylon in a survey of its indigenous craft and in experimentation on the introduction of mechanization. An important element toward conversion of the fishing operations is the action of various governments in conducting deep-sea operations with vessels from overseas; these include the Government of India's Deep-Sea Scheme operating from Bombay (with which may be associated the operations of a Japanese unit from the same port), the Government of West Bengal's project with Danish vessels operating out of Calcutta, and the continuation by the Government of Ceylon of its trawling operations on the Wadge Bank. Finally, in this connection should be noted the apparently highly successful mothership operations in fishing for tuna in the Pacific by Japanese companies under government sponsorship.

The importance of this development is fully appreciated by FAO which, in addition to its direct technical aid to certain governments, is preparing plans for technical instruction to fishermen in connection with mechanization, and to fisheries administrators in connection with governmental aspects of such programs.

The most important aspect to note in respect of inland fisheries is the growth of interest. Active governmental programs in India, Indonesia, Pakistan, the Philipines and Thailand, are supplementing other efforts to extend fish cultural practices.

(*b*) Harbor Facilities

Plans for a fish harbor at Karachi have been drawn up by specialists supplied under the FAO Expanded Technical Assistance Program and the Government of Pakistan has approved the project for its construction.

Survey work is being done in West Bengal and in East Pakistan to determine the need for these facilities in the Gangetic Delta.

The Government of Singapore's Harbor Control point, which assists fishermen in their contacts with governments, has been further developed and has made a 24-hour service.

(*c*) Marketing

New fish market premises have been constructed in Bombay.

The Karachi fish harbor plans include provision of marketing facilities.

Marketing of fish from the Gangetic Delta is being surveyed on behalf of the Governments of West Bengal and East Pakistan under the FAO Expanded Technical Assistance Program.

The Singapore Government has continued a survey of its fishing industry preliminary to embarking on a marketing scheme; a formal scheme is understood to be under consideration.

The Hong Kong Government has completed the construction of new fish market premises at Aberdeen; at the same time the market system has evolved further, and several modifications in the procedure at the Kowloon market yield important increases in efficiency.

The Government of Ceylon is conducting experiments in various aspects of the marketing system.

(*d*) Processing

Whilst it would appear that further progress has been made by certain countries in the re-establishment of their processing industries, chiefly for export, as for example, Cambodia, Hong Kong, and Japan, the picture in this sector of the industry is essentially unchanged. Some apparently successful experiments have been conducted in Hong Kong in the use of artificial drying equipment.

(*e*) Trade

Most available information on trade in fish and fisheries products (*see* Tables 2 and 3), although incomplete, shows clearly that international trade in these commodities has not yet returned to its prewar level. Of the total of 196,000 metric tons of imports shown, almost half was cured fish: of the remainder a large proportion (about 21%) was canned, more than half of which was imported by the Philippines.

(*f*) Production

Table 4 gives the latest estimates of production. The numerous gaps in the table cannot as yet be removed although statistical work is being actively developed in the region. On the other hand, attention must be drawn to the possibility that production is significantly underestimated in certain countries where it yet proves impossible to attempt an assessment of subsistence catch. Recent preliminary investigations show that the magnitude of this neglected element is quite considerable. It is impossible, in view of the lack of full data, to reach any conclusion on whether production in 1951 and 1952 was more or less than that of previous years. The main impression from available evidence is that there may have been a slight recession in total production.

TABLE 2 - IMPORTS OF FISH AND FISHERIES PRODUCTS OF CERTAIN INDO-PACIFIC COUNTRIES

Year	Country	Total	Fresh or Frozen Fish	Cured Fish	Canned Fish	Crustaceans and Molusks	Fish Meals and Fertilizers	Other
		Metric tons						
1950...	Brunei	100	*	100	...	...	...	...
1950...	Ceylon	35 600	*	32 000	600	...	3 000	*
1950...	China	16 400	*	15 200	...	1 100	...	100
1950...	Hong Kong	24 800	1 200	...	4 400	16 500	700	2 000
1949/50	India	6 100	...	3 200	200	...	1 400	1 300
1950...	Indo-China	300	*	200	...	100	...	...
1950...	Indonesia	16 200	*	13 200	2 200	700	...	100
1950...	Japan	5 800	*	2 000	*	100	...	3 700
1950...	Malaya	58 300	5 300	22 800	9 900	...	17 700	2 600
1950...	North Borneo	300	...	...	300	...	...	...
1950 ...	Pakistan	—	—	—	—	—	—	—
1950...	Philippines	28 900	*	500	26 500	1 300	600	*
1950...	Sarawak	3 700	*	2 100	800	*	*	800
1950...	Thailand	500	*	400	100	...	...	...

* Less than 100 metric tons

TABLE 3 - EXPORTS OF FISH AND FISHERIES PRODUCTS OF CERTAIN INDO-PACIFIC COUNTRIES

Year	Country	Total	Fresh or Frozen Fish	Cured Fish	Canned Fish	Crustaceans and Molusks	Miscellaneous Aquatic Animal and Plant Products	Other
		Metric tons						
1950...	Brunei	—	—	—	—	—	—	—
1950...	Ceylon	900	100	*	...	...	700	100
1950...	China	*	...	...	...	*	*	...
1950...	Hong Kong	18 000	300	...	5 000	8 700	3 800	200
1949/50	India	16 300	...	16 300	...	...	*	...
1949...	Indo-China	3 700	*	1 900	*	700	*	1 100
1950...	Indonesia	12 600	300	200	...	*	12 000	100
1950...	Japan	62 000	13 400	3 100	20 900	14 000	2 300	8 300
1950...	Malaya	25 300	100	17 500	3 300	...	3 300	1 100
1950...	North Borneo	1 300	...	800	...	100	400	*
1950...	Pakistan	15 700	5 700	5 900	...	...	...	4 100
1949...	Philippines	700	100	200	...	*	400	...
1950...	Sarawak	400	*	100	...	100	200	...
1950...	Thailand	21 900	*	21 000	...	900	...	...

* Less than 100 metric tons

(*g*) Prospects

The prospects and the development of the fisheries of the region that can be stated at this juncture, in some measure of confidence, may be summarized as follows :

Inland Fisheries. Improvements by conservation measures for the wild stock and heavily increased production by the use of stock-

TABLE 4 - TOTAL ANNUAL CATCH OF FISH, CRUSTACEANS AND MOLLUSKS IN CERTAIN INDO-PACIFIC COUNTRIES, 1938 AND 1947-51

Country	Prewar		Postwar				
	Year	Quantity	1947	1948	1949	1950	1951
		Metric tons					
Burma	...	...	...	...	...	43 200	...
Cambodia	...	...	...	...	...	...	156 800
Ceylon	...	...	...	24 000	36 000	43 000	37 000
China	...	...	...	2 500 000	3 000 000	...	...
Hong Kong	1938	29 900	12 000	21 200	27 000	31 000	31 000
India	...	...	662 000	530 000	569 600	828 600	762 700
Indo-China	...	266 000	...	...	410 000	...	...
Indonesia	1940	472 000	...	350 900	420 000	...	...
Japan	1938	3 521 000	2 967 100	2 453 800	2 980 400	3 793 600	3 796 700
Korea	1938	1 954 700	...	...	...	...	...
North	1938	1 326 000	...	...	...	...	...
South	1938	628 700	302 000	285 300	299 900	219 400	276 900
Macau	...	...	9 000	...	...	...	...
Malaya and Singapore	1936-40	87 000	119 000	139 000	162 000	185 000	177 000

ing methods especially in conjunction with paddy conservation. Considerably increased production in certain areas by the adoption and extension of fish culture practices in fresh and brackish waters.

Marine Fisheries. In some areas, improvement in the quality of the yield by introduction of conservational measures and in other cases increase in quantity by extended operations. In the pelagic neritic, improvement by stabilization of yield from increased knowledge of the stocks. In the demersal, direct increase in production by extension and intensification of operations which will be accomplished by mechanization of craft and gear. It must be assumed that the increase is also likely in this zone by fishing the mid-waters. In offshore waters, important increment to the catch by the development of new fisheries to exploit resources at present neglected.

III. Government Programs

It is extremely encouraging to observe that governments of the area without exception are actively developing fishery programs. Important signs of such developments are the expansion of administrative services ; the holding in various places in the region of meetings and conferences of fisheries officers, for instance, in Pakistan, India and Viet-Nam ; and the appearance of regular reports of fisheries administrations, such as those from East Pakistan, various states and provinces of India, Ceylon, Malaya and Singapore, and Hong Kong ; in the case of Malaya this includes a regular monthly record of the industries.

Research work is rapidly developing as is shown by the growing number and the improving quality of the technical papers being published. Within the past few years, certain institutions have been

re-established and new institutions created as, for instance, the Inland Fisheries Institute of Phnom-Penh, and the Dagatdagatan Saltwater Experimental Fish Farm. In addition, action has been initiated for the creation of a fresh water institute at Penang (*see FAO Fisheries Bulletin*, Vol. 4, No. 6, pp. 15-17), a marine institute in Singapore, and a fisheries institute in Hong Kong.

Many governments are devoting much attention to the socio-economic problems of the industries. Schemes of financial assistance have been developed in Bombay Province, Ceylon, Singapore and elsewhere. Schemes for the promotion of co-operatives and for the improvement of education and health facilities for the fishing populations have been undertaken in some parts of the region. Practical schemes for improving harbor facilities and the roads used by fishermen for transporting their catch, and for giving safety at sea, have been developed in certain places.

Without exception, the administrators of the region have become keenly interested in the development of a statistical program and the response to the invitation to participate in the Indo-Pacific Fisheries Statistics Training Center was unanimous among the governments of the region.

Most countries of the region have projects of economic development of the fisheries industries. Many relate to mechanization of fishing operations, but some for improvement of harbor facilities, development of fish culture, and dissemination of technical instruction have also been initiated.

Correction. Professor Johan Ruud has asked that the following correction be made in his article "Modern Whaling and its Prospects" which appeared in *FAO Fisheries Bullettin*, Vol. 5, No. 5. It was brought to his attention by F.F. Anderson, Director of the Commonwealth Fisheries Office, Australian Department of Commerce and Agriculture, that the Australian Whaling Commission is not responsible for regulating Australian whaling as stated on pages 172 and 173. The Commission is simply an operating body formed by an Act of Parliament in 1949 for the purpose of carrying on whaling activities in certain waters on behalf of the Commonwealth Government of Australia.

The control of the whaling industry is carried out through the Commonwealth Fisheries Office on behalf of the Minister of Commerce and Agriculture and under the Whaling Act 1935-48. The quotas are fixed by the Minister after receiving recommendations from the Director of the Fisheries Office Every endeavor is made by the Australian Government to avoid overfishing, thereby giving effect to the aims and objectives of the International Whaling Convention.

Conferences and Meetings

International Council for the Exploration of the Sea (ICES)

The Fortieth Annual Meeting of the ICES was held in Copenhagen, Denmark, from 29 September to 7 October 1952. Dr. K.A. Andersson, who retired as President after four years in that office, was made Honorary President. The new president, Mr. A.T.A. Dobson of the United Kingdom, presided over the general sessions. The other officers of the Council are: first vice-president, Prof. Jean le Gall (France), and vice-presidents, G.L. Lienesch (Netherlands), Prof. H.U. Sverdrup (Norway), Dr. A. Vedel Taaning (Denmark), Secretary-General, Villy Dessau.

Representatives from Belgium, Denmark, Finland, France, Western Germany, Iceland, Ireland, Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom, as well as observers from Canada, FAO, the Indo-Pacific Fisheries Council, the International Council for the Northwest Atlantic Fisheries, and the United States attended.

Papers presented included:

E. Postel. "Le merlu noir (*Merluccius senegalensis* Cadenat)." [The Hake *Merluccius senegalensis* Cadenat]
"Les facies bionomiques des côtes du Sénégal." [Bionomic Aspects of the Coast of Senegal]
"Observations hydrologiques au large de Dakar." [Hydrological Observations off Dakar]
"Contribution à l'étude des Thonidés de l'Atlantique tropical." [Contribution to the Study of the Tropical Atlantic Thonides]

Pedro da Franca. "Etude comparative de quelques caractères morphologiques et biométriques de *Merluccius merluccius* L. et *Merluccius senegalensis* Cadenat." [Comparative Study of Some Morphological and Biometric Characteristics of the Hake *Merluccius merluccius* L. and *Merluccius senegalensis* Cadenat]

B. B. Rae. "A Preliminary Note on the Scottish Hake Fishery."

Claude Maurin. "Etude comparative du merlu blanc (*Merluccius merluccius* L.) et du merlu noir (*Merluccius senegalensis* Cadenat)." [Comparative Study of the Hakes *Merluccius merluccius* L. and *Merluccius senegalensis* Cadenat]

P. Korringa. "Epidemiological Observations on *Mytilicola intestinalis* Steuer in the Zealand Waters."

H. A. Cole and M. N. Mistakidis. "A Device for the Quick and Accurate Measurement of Carapace Length in Prawns and Shrimps."

R. J. H. Beverton. "Some Observations on the Principles and Methods of Fishery Regulation."

J. R. Lumby. "A Note on Synoptic Hydrographic Charts."

M. Fontaine. "La function hypophyso-thyroïdienne des poissons dans les rapports avec leur morphologie et leur comportement." [The Hypophysio-thyroid Function of Fish in Relation to their Morphology and Behavior]

Leiv Rosseland. "Salmon and Sea Trout Research in Norway, 1952, and a Review of Some Long-term Tagging Experiments."

K. A. Pyefinch. "Report on the Tagging Experiment at Altens, near Aberdeen, Scotland, April-May, 1952."
G. Dannevig. "Tagging Experiments on Cod, Lofoten, 1947-52. Summary."
Gunnar Rollefsen. "The Selectivity of Different Fishing Gears in Lofoten."
H. Mosby. "The Bottom Water at Weather Station M."
G. C. Trout. "English Cod Marking in the Barents Sea 1951."
Finn Devold. "Preliminary Report from the Cruise with *G. O. Sars* in the Summer 1952."

Much of the work of the meeting was carried out by the following committees and sub-committees : Organization of Combined Hydrographical-Biological Investigations ; Shellfish ; Plankton ; Salmon and Trout; the Consultative; Herring; European Atlantic; African Atlantic; Transition Area ; North-eastern Area ; and North Sea.

International Fishing Boat Congress

FAO will hold an international fishing boat congress in two sessions, one in Paris, from 12 to 16 October 1953 and the other in Miami, Florida, from 16 to 20 November 1953. (For details *see* Fisheries Division Activities).

International Commission for the Northwest Atlantic Fisheries

The Commission will hold its third annual meeting at the Bingham Oceanographic Laboratory, Yale University, New Haven, Connecticut, U.S.A., from 25 to 30 May 1953. The special committee on the Commission's research program will also meet at the Laboratory from 21 to 23 May. Further information about the meeting can be obtained from Dr. Erik M. Poulsen, Executive Secretary, International Commission for the Northwest Atlantic Fisheries. St. Andrews, New Brunswick, Canada.

XIVth International Congress of Zoology

The Congress will be held in Copenhagen, Denmark, from 5 to 12 August 1953. More than 500 zooligists from 44 countries outside Denmark have already indicated their intention to attend. There will be 20 or more sections relating to practically all aspects of zoology. Of especial immediate interest to fishery workers will be those on zoogeography and marine ecology, which are being organized by Prof. Dr. E. Sparck and Dr. G. Thorson, respectively. In addition to general meetings and those on special topics, excursions will be made which will include visits to the university fresh water biological laboratory at Hillerød, to the Skallingen laboratory of dune; marsh and wadden investigations at Esbjerg ; a four-day excursion to south-west Jutland to see the fauna of brackish water and the eutrophic lake, an excursion on the Limfjord to see shallow water fjord fauna, animal communities, oyster beds, and demonstrations of oyster dredging, trawling and bottom sampling with the Petersen Grab and, finally, a one day excursion to the deep part of the Skaggerak by a Royal Danish naval vessel with

a demonstration of hydrographical investigations, deep sea trawling, etc. Further information can be obtained from the Secretary-General, Dr. Anton Fr. Bruun, XIVth International Congress of Zoology, 1953, Zoologisk Museum, Universitet, Krystalgade 27, Copenhagen K, Denmark.

Gulf and Caribbean Fisheries Institute

The Institute held its fifth annual meeting at Miami Beach, Florida, U.S.A., from 17 to 21 November 1952.

Representatives of the Governments of the Caribbean and southeastern states of the United States, as well as representatives from the United States Fish and Wildlife Service, the Atlantic States Marine Fisheries Commission, the Gulf States Marine Fisheries Commission, the Southeastern Fisheries Association, the National Fisheries Institute, and other conservation agencies, institutions, universities and government departments, attended.

Sessions were held on commercial fisheries, at which the following papers were presented :

Exteen Corbett. "The Outlook for the Menhaden Fishery of the Atlantic Coast."
Theodore M. Miller. "Some Technological Aspects of Menhaden Products."
Wayne M. Waller. "Tomorrow's By-products."
Karl Envoldsen. "Quality Controlled Fishery Products."
A. J. Wegmann. "The Case against Free Importation of Shrimp into the United States."
William L. Hardee. "The Case for Free Importation of Shrimp into the United States."

on technology and exploratory fishing :

Louis S. Mowbray. "Exploratory Fishing in Bermuda Waters."
Carl B. Carlson. "Shrimp Exploration of the *M. V. Antillas*."
Stewart Springer. "A Review of the Gulf of Mexico Exploratory Fishing."
Virgil E. Harris. "Some Practical Aspects of Electrical Fishing in the Sea."
J. B. Higman and C. P. Idyll. "Holding Fresh Shrimp in Refrigerated Sea Water."
Earle L. Divers. "Practical Aspects of the Freezing of Shrimp."

on fisheries economics :

Philip van Gelderen. "Fisheries in the Netherlands Antilles in its Present State and Future."
George B. Hurff and Carter C. Osterbind. "The Marketing of Florida Seafood."
Walter H. Stolting. "Survey of Household Consumer Preferences for Fish and Shellfish with Particular Emphasis on the Southern Region."
Richard A. Kahn. "What Determines Fish Prices ?"
Charles Bowling. "The Importance of 'Exempt' Trucks to the Fisheries Industry."

and on shell fisheries :

Richard P. Hardison. "Bacteriological Standards for Oysters Grown in a Semi-tropical Climate."

Philip A. Butler. "Importance of Local Environment in Oyster Growth."
Robert M. Ingle. "Notes on the Effects of Dredging upon Fish and Shellfish."
A. F. Chestnut and W. E. Fahy. "Studies on the Vertical Distribution of Oyster Setting in North Carolina."
G. Robert Lunz and G. Francis Beaven. "A Preliminary Report on some Experiments in the Production and Transplanting of South Carolina Seed Oysters to Certain Waters of the Chesapeake Area."
Sammy Ray, J. G. Mackin, and James Boswell. "Quantitative Measurements of Parasitization of Oysters by *Dermocystidium marinum*."
D. W. Pritchard. "Distribution of Oyster Larvae in Relation to Hydrographic Conditions."
David H. Wallace. "A Critique of Present Biological Research on Oysters."

Chairmen at the sessions were Wayne M. Waller, Andrew W. Anderson, Richard A. Kahn and William W. Anderson, respectively.

The following papers were also presented:

Mary Schulman. "A Suggested Reorganization of Florida Fishery Laws."
E. W. Roelofs. "Distribution of Fishery Resources in Relation to Hydrographic Conditions in North Carolina Estuaries."
Dale F. Leipper. "Computed Ocean Currents in the Gulf of Mexico."
Luis R. Rivas. "Progress in the Western Atlantic Bluefin Tuna Investigation."
G. C. Broadhead and C. P. Idyll. "Suggested Changes in Florida Mullet Regulations."
Dudley W. Wiles. "Review of the Caribbean Fisheries Conference, Trinidad, March, 1952."

In addition to these sessions and presentation of these papers, there were general discussions on:

Problems of the Commercial Fishing Industry;
Trends in Exploratory Fishing and Technological Research;
Economic Trends in Commercial Fisheries;
The Emphasis in Oyster Research in the Gulf Region in the last;
Caribbean Fishery Problems.

International Canned Foods Committee

The Annual Meeting of the Comité international permanent de la conserve was held in Madrid from 13 to 17 October 1952, when over 80 delegates and technical advisers from the following countries attended; Belgium, Denmark, France, Morocco, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Delegates discussed reports of the sub-committees concerned with standardization, definitions and regulations affecting canned foods. The Scientific Sub-Committee has continued its examination of problems related to nutritive value of canned foods, analysis, particularly of tomato purée, legislation and bacteriology. A new section was formed to study the behavior of the container for canned foods in all its aspects. A committee was also formed to study the public's interest in canned foods.

Fisheries Division Activities

International Fishing Boat Congress

Since the FAO Fisheries Division initiated its work on the improvement of fishing boat design, construction, etc., there has been an ever-increasing interest in, and support for, this field of work. Thus, the publication of Jan-Olof Traung's article, " Improving the Design of Fishing Boats, " in the *FAO Fisheries Bulletin*, was widely read and commented upon throughout the world and was reprinted in six languages.

Many experts and editors of technical publications have called on FAO to arrange an international congress to provide for exchange of experience and information in this field. In co-operation with the United States Fish and Wildlife Service and the French Ministry of the Merchant Navy, FAO has made inquiries among technical research institutions, fishing boat builders, and within the fishing industry itself, and found that the interest in such a congress is very great indeed.

FAO is now arranging, to hold such a congress. It will be held in two sessions, one in Paris, from 12 to 16 October 1953, and one in Miami, Florida, U S.A., from 16 to 20 November 1953. This unique arrangement is made to allow for attendance by as many interested persons as possible. The congress in Paris will be conducted in French and English and mainly count on participation from Europe and the Near and Far East while that in Miami will be held in English and Spanish and mainly count on participation from the Americas.

The same papers will be presented at both meetings ; specialists from FAO will arrange for the presentation of papers in the event that authors are unable to attend. At the congress in Miami, summaries of the discussions in Paris will also be given. The papers for the congress will be distributed beforehand ; they will only be summarized at the beginning of each session, most of which will be devoted to discussion. Among the topics that will be covered are :

1. review of fishing boat designs in various countries ;
2. economic size of fishing craft ;
3. influence of hull shapes on resistance and seakindliness ;
4. construction details ;
5. engines and propellers ;
6. deck equipment ;
7. safety at sea ;
8. fish handling aboard ;
9. factory ships.

The congress will be open for government delegates and for private individuals concerned with the subjects covered. If sufficient interest is shown, it is expected that the participants may also discuss the possibility of establishing some formal mechanism through which continued international co-operation in the field covered by the congress can be secured.

Program of Work for 1953

The Council of FAO at its Sixteenth Session approved the following program of work for fisheries in 1953 :

1. Direction

Direction involves the planning of such programs of work in Fisheries which will best contribute to the aims of the Organization and still be within the realm of possible accomplishment with the resources available. It involves the co-ordination of the work in executing these programs at Headquarters and in the regions, the preparation of budgets and estimates and the general management of the work of the Division.

Under this heading also come those more general tasks which include several branches of fisheries knowledge or endeavor, such as the *FAO Fisheries Bulletin*, the preparation of papers for the Conference and Council.

The consultation work with respect to governmental, fishery administrative methods and formulations of policies for fisheries development also come under this heading. " Direction " also includes the responsibility for ETAP in fisheries matters and the co-ordination and integration of this with the rest of the work.

(Continuing project)

Technical Assistance Projects

Finland	— Started April, finished September 1952.
Syria	— Started June 1952, continuing through December 1953.
Colombia	— Request received ; under discussion.
Korea	— Started August, continuing through January 1953.

1.2 *Fisheries Bulletin*

The *FAO Fisheries Bulletin* is issued bi-monthly and is addressed to government administrators and others concerned with the fisheries industry. It contains information on current fisheries developments

and serves as a vehicle for summaries of certain parts of the work resulting from the projects listed below. It also includes brief notes on current fisheries publications, fisheries films, meetings, and notes from correspondents on fisheries situations in various parts of the world.

(Continuing project)

2. Fisheries Economics and Statistics

Under this heading comes responsibility for economic advisory and analytical work for collection, correlation and dissemination of statistics on fish production, processing and trade, and collaboration in the field with governments, similar to duties performed in the field of agriculture by other organizational units of FAO.

Some of the activities in the field will be reflected in contributions to the *FAO Fisheries Bulletin* and the *Monthly Bulletin of Agricultural Economics and Statistics*. Others will result in joint reports with other international bodies, such as the report on *Fish Marketing in OEEC Countries*, and in publications such as the *Yearbook of Fisheries Statistics*.

Activities include preparation of the fisheries section in *The State of Food and Agriculture*, and other documents which the Director-General might decide to have prepared on an organization-wide basis. They also include co-operation with other international bodies such as the International Bank for Reconstruction and Development, the OEEC and others.

2.1 *International Co-ordination of World Fisheries Statistics*

An international co-ordination and digest of statistics is an indispensable requisite to consideration of economic policy in fisheries. This project consists of the continuation of the *Yearbook of Fisheries Statistics*, the first of which appeared in 1948, covering the information available to the end of 1947. The second yearbook covered more countries and brought the statistics up-to-date with material available up to May 1950. It was published in the early part of 1951. The third yearbook, which is to be published in 1952, will deat with additional topics and will bring many statistical series up-to-date trough the calendar year of 1951.

Certain statistical information, which is ultimately used for the purpose outlined above, is made available at periodic intervals throughout the year in the *FAO Fisheries Bulletin*, and, starting with June 1952, in the *Monthly Bulletin of Agricultural Economics and Statistics*.

The above mentioned fisheries statistics will facilitate the making of general summaries to indicate the most significant feature of current trends in the industry. They will also be used as the basis for short

appraisals of primary fisheries production, processing and trade in specialized commodities.

(Continuing project)

2.2 *Economic Appraisals as Applied to Fisheries*

Several countries contemplate projects, some of them to be implemented under ETAP, which call for economic appraisals of existing an planned fisheries industries. The economic appraisals will be co-ordinated and collated in order to increase the efficiency of the projects.

The possibilities for utilizing work already done and methods employed by universities and other research institutions in fisheries economics will be explored and suitable arrangements made.

Under this heading is also grouped the work of the economics and statistics staff in acting as consultants to regional training courses in fisheries.

(Continuing from 1951 into 1953)

Technical Assistance Projects

Brazil	— Started September 1951, finished April 1952.
Ceylon	— To begin about February 1953, for one year.
Chile	— Started June 1951, finished December 1952.
India	— Started September 1952, continuing through January 1953.
Pakistan, West	— To begin about April 1953, continuing through November 1953.
Pakistan, East	— Started September 1952, finished December 1952.
Saudi Arabia	— To begin about March 1953, continuing to February 1954.
Uruguay	— To begin early 1953 for one year.

2.3 *International Standardization of Fisheries Statistical Methods*

Under this heading is grouped work connected with editing and publishing the report of the meeting of world fisheries statisticians held in Copenhagen, Denmark, 26-30 May 1952, and implementation and recommendations made by the meeting.

The work may also develop advantageously into :

1. further work with governments and international institutions leading to greater uniformity in methods of reporting ;
2. work in individual countries in assisting their governments to improve the design of the statistical system in use, particularly those countries which are under-developed ;

3. spreading of knowledge about statistical techniques to be applied in economic fisheries research.

(Continuing from 1951 into 1953)

2.4 *Advice on Organitional Forms in Fisheries Enterprises*

Fisheries administrators of many countries want advice on the most adequate entrepreneurial arrangements for fisheries development, and as to the systems which might be adopted to transfer the tools for production from government ownership to the hands of the operatives. Methods for doing this may vary from country to country depending upon conditions and the type and degree of governmental organization.

Work is already under way describing the experience of various governments in this field and upon the ways in which fishing and the fish processing industry is organized. Such information, coupled with on-the-spot studies, will be useful to individual countries in the choice of appropriate methods.

(Continuing from 1952 into 1953)

Technical Assistance Projects

Turkey — (To begin about March 1953 for one year).

3. Fisheries Biology

This work is concerned with rendering assistance to governments in matters pertaining to the biology of marine and fresh water animals and plants, including the evaluation of fisheries and other living aquatic resources, the scientific study of aquatic animals and plants with a view to their full use and conservation. Also included here is the culture and the farming of aquatic animals and plants for human food.

One responsibility of the Biology Branch is the fostering and development of co-operation between fisheries biology workers both on a regional basis such as is now being done through the regional fisheries councils and on a world basis through Headquarters' activities. Another important function of the staff concerned is to keep informed about the world's fisheries resources, particularly those which are unused or capable of further exploration and those which are being overfished.

Provision is made under this heading for the preparation of material required for Conference and Council consideration and for advice on, and contribution to, work engaged in by other specialized agencies and international organizations.

Technical Assistance Projects

Israel — To begin about April 1953 for one year.

3.1 *Inland Fisheries*

As stated in the 1951 program, for many areas supplies of animal protein can be readily increased through the establishment and improvement of fish cultural practice. Land, unsuitable for agriculture, can often be converted into fresh, brackish or salt water fish ponds which, in tropical climates, produce surprisingly high yields. In many cases parts of irrigation systems can be used for fish culture. When the fish produced in canals or ponds are used by the peasant family, the animal protein portion of the daily food needs can be furnished without the necessity of preservation, storage or transport. While such methods are traditional in many parts of the Orient, improvement in management and practice is needed. Moreover, many countries with suitable climates and large populations, which need more food, have yet to adopt such developments. There are also natural sources of fresh water fishes, such as lakes, streams and rivers, which need to be properly managed to produce a maximum sustained yield of fish of the quality and quantity desired. This project occupies a major part of the activities in the work of the staff concerned and much of it will be conducted in the field. It falls into four major divisions :

1. rendering assistance to governments in initiating or improving their pond fish cultural undertakings, e.g. Haiti, India (West Bengal), Israel, Jordan, and Thailand ; other countries will be similarly assisted in 1953 ;
2. gathering scattered information concerning fish cultural practices and fresh water fishery biology, arranging it in systematic form and making it available for use by government workers who are engaged in developing and guiding work in fish culture and lake and stream improvement ;
3. assisting governments by advising them on suitable administrative services for the implementation of fish cultural policies and management of inland fisheries ;
4. planning and operation of fish culture seminars, e.g. the seminar in Bogor, Indonesia, May to June 1952.

(Continuing project)

Technical Assistance Projects

Haiti — Started December 1950, continuing through December 1953.
Started September 1952, continuing through August 1953.

India — Started May 1952, continuing through April 1953. Draft Agreement before Government for signature.

Iraq — Started July 1952, continuing through June 1953.

Israel — Started August 1952, continuing through January 1954.

Mexico	— To begin March 1953 for one year.
Paraguay	— To begin May 1953 for one year.
Philippines	— Request received ; under discussion.
Syria	— To begin June 1953 for one year.
Thailand	— Started September 1951, continuing through December 1953.
Yugoslavia	— To begin April 1953 for one year - two experts

3.2 *Catalogue of Government Fisheries Agencies, Fisheries Research and Educational Institutions, and Directory of Personnel Working on Fisheries*

This project involves the compilation of catalogues of government fisheries agencies and fisheries educational and research institutions, with a description of their functions programs and organization ; and the organization of a directory of names of personnel working on fisheries, together with their types of work. They are designed to assist government administrators and research workers in formulating their management and educational programs, especially in the less developed areas. In addition, they will serve to encourage co-operation and the exchange of information between institutions and individual workers, and to point out experiences in the more developed countries. A catalogue for North and South America was published in 1951. The information for further catalogues of other parts of the world has now been supplied by the Member Governments concerned.

(Continuing from 1951 into 1953)

3.3 *Marine Fisheries*

There are many areas in the oceans which, although thought to be rich in fisheries resources, are being fished to a slight extent or not explored However, there is at present emerging a growing interest on the part of many countries in the expansion of fisheries activities and the use of hitherto unused resources in order to step up food supplies.

Assistance is being rendered to governments by supplying them with the existing information and advising them on the steps necessary to appraise their marine resources.

The implementation of the necessary fisheries biological surveys is conducted under the Technical Assistance Program. Such work is kept under continual review and the results evaluated.

(Continuing project)

Technical Assistance Projects

Ceylon	— To begin about March 1953 for one year.
Chile	— Started October 1951, finished April 1952 ; to be extended.
Costa Rica	— To begin about February 1953 for one year. To begin about April 1953 for one year.
Ecuador	— Started August 1951, finished April 1952 ; to be extended.
Libya	— Started September 1951, finished December 1951.
Panama	— Started November 1952, continuing through December 1953 - two experts.
Saudi Arabia	— Started Oct. 1952. continuing through April 1953.
Somaliland, Italian	— Started Feb. 1952, continuing through June 1953.
Turkey	— To begin January 1953 for one year.
Uruguay	— To begin early 1953 for one year. Request received ; under consideration.
Yugoslavia	— To begin about June 1953, continuing through November 1953.

3.4 *Handbook of Fish Culture in Warm Waters*

The principles and methods of fish culture in ponds and natural inland waters have been the object of intensive study in Europe and North America. On the other hand, the fairly well-developed cultivation of various types of fish ponds and rice fields in Asia, Africa, the Far East and Latin America is, to a large extent, carried out empirically.

Realization of the importance of fish culture as a means of increasing the supply of animal protein has aroused great interest in the latter countries. They lack, however, information on the practical application of the principles of pond fish culture.

European and North American fish culturists have several classical text books on fish culture at their disposal, whereas fish culturists from the remaining parts of the world have only scattered information available in periodicals and pamphlets. A comprehensive handbook on fish culture methods in tropical and sub-tropical countries will greatly contribute to the extension and application of knowledge on the culture of fishes in these regions.

Initially four pamphlets will be published covering each of the following subjects : Pond Culture of Fresh Water Fishes, Brackish-water Fish Culture, Fish Culture in Reservoirs and Irrigation Canals and Paddy-cum-Fish Culture.

Subsequently, these four pamphlets will form the basis for a "Handbook on Fish Culture in Tropical and Semi-Tropical Waters." Such a volume must precede an expansion of the much needed extension work in this activity.

(Continuing from 1952 and completed in 1953)

4. Fisheries Technology

The Technological Branch is responsible for all work related to the technological and engineering aspects of fishing boats, gear, etc., and handling, processing and distribution of fisheries products. The work is carried out :

1. by collection and distribution of technical information, mainly through *World Fisheries Abstracts* ;
2. through the furtherance of international co-operation in the fisheries technological field, largely through the FAO regional fisheries councils or regional groups of technologists, special meetings ;
3. through direct assistance to groups of countries or individual countries with regard to specific technological information.

Activities include the preparation of reviews of books and films and the occasional preparation of articles for the *FAO Fisheries Bulletin.*

Provision is also made for a certain amount of work required in the preparation of documents, etc., for Conference and Council consideration and advice on, and contribution to, work engaged in by other U.N. agencies.

4.1 *World Fisheries Abstracts*

This project, which is a major activity of the staff concerned with fisheries technology, provides for the continued publication of summaries of the most important articles on fishing and fish handling and processing techniques appearing in current literature. The summaries, which include illustrations and are published in English, French and Spanish, are printed in such a way that they may be filed for ready reference. This cumulative collection of information forms a basis for the Division's advisory work and for experts employed under the Technical Assistance Program, lecturers at fisheries training centers, schools, etc.

For the reviewing of the literature and the preparation of the original abstracts, FAO relies to a considerable extent on the co-operation of fisheries technologists in the various countries so that the work-load for the Division may be reduced. A considerable part of that work-load does derive from the fact that, due to the highly technical nature of this material, it is necessary to have the translation made by fisheries technologists on the staff. In connection with the translations, much work has had to be done to develop word lists for fisheries technological terms. It is proposed to publish such lists for English/French and English/Spanish in mimeographed form, to be sent to fisheries workers for criticism and use.

Much of the usefulness of these Abstracts depends on their effective distribution. Continuous steps to improve this will be taken in co-operation with local fisheries administrators, research workers, etc.

(Continuing project)

4.2 *Fishing Boats, Gear and Methods*

All countries striving to develop their fisheries have a continuing need for information on fishing boat design, fishing methods and gear, etc. This project will include the preparation and dissemination of material describing fishing boats and methods but the major activities will consist of direct advisory work carried out in the field. Experience has shown that even the most developed countries can benefit from the information FAO staff can provide with regard to these matters.

It is proposed to hold twin meetings on fishingboat design in the U.S.A. and France in May 1953 and to use the papers presented and summaries of the discussions for the preparation of a handbook.

It is proposed to explore also the possibilities of the preparation of a handbook on fishing gear and methods which would gather widely-scattered information and make it available in several languages to be used in fisheries training centers, fisheries educational institutions and by fisheries workers. It is proposed that such a handbook should consist of chapters written by experts in the various countries and should be edited by the FAO staff.

All work in this field would be carried out in close co-operation with fisheries biologists.

(Continuing project)

Technical Assistance Projects

Ceylon	— Started July 1951, finished June 1952 ; extended for one year as from February 1953. To begin February 1953, continuing through 1953.
India	— Started November 1952, for one year. Draft agreement before Government for signature - three experts.
Iraq	— Started August 1952 for one year.
Israel	— Started May 1952, continuing through April 1953.
Liberia	— Started February 1952, continuing through January 1953.
Pakistan, West	— Started July 1951, finished October 1951. To begin January 1953, continuing through April 1953.
Philippines	— Request received ; under discussion.
Saudi Arabia	— Started October 1952, continuing through March 1953.
Somaliland, Italian	— Started February 1952 continuing through June 1953. Started September 1952 for one year.
Syria	— To begin March 1953, for one year.

Turkey — To begin about March 1953 for one year.
Uruguay — To begin about June 1953, for one year.
Yugoslavia — To begin about April 1953, continuing through September 1953.

4.3 *Handling, Processing and Distribution of Fisheries Products*

The experience of the Organization has demonstrated that the lack of proper harbor, handling, processing or distribution facilities is often a more important deterrent to fisheries development than lack of boats, gear, etc. It is evident that no fisheries development can occur until proper steps have been taken to assure effective utilization. Here again, some of the work would be the preparation of information material to be furnished to countries, but most of the work would be carried out in the field by direct technical assistance.

A special part of this project would be devoted to the continedu study of certain fish preservation methods in use in warm climates. It is found that several little-known but very effective preservation methods exist which might be given a wider use than heretofore. This project would be carried out in close co-operation with the FAO Indo-Pacific Fisheries Council (IPFC).

(Continuing from 1951 into 1953)

Technical Assistance Projects

Ceylon — To begin February 1953, continuing through July 1953.
Colombia — Request received ; under discussion.
Ecuador — Started September 1951, finished September 1952.
India — Draft agreement before Government for signature.
Liberia — Started March 1952 for one year.
Pakistan, West — Started July 1951, finished November 1951
Pakistan, East — Started October 1952, continuing through February 1953
Saudi Arabia — To begin about March 1953, continuing through February 1954.
Turkey — To begin about March 1953 for one year - two experts.
Uruguay — To begin early 1953 for one year.
To begin about June 1953 for one year.
Yemen — One month's reconnaissance survey September 1952 - completed.

Yugoslavia — To begin April 1953, continuing through September 1953.
Started September 1952, continuing through March 1953.
To begin April 1953 for one year.

4.4 *Co-operation between Fisheries Technologists*

Under this heading comes general assistance to be given to the FAO regional fisheries councils which, to a large extent, occupy themselves with technological problems. A special task of the Headquarters' Fisheries staff is assistance to the Interim Committee on Fish Handling and Processing for which FAO provides secretarial assistance.

(Continuing project)

4.5 *World Practices in Fish Inspection and Food and Public Laws Affecting Fisheries Products*

A summary of world laws and practices in this field was completed by the Organization in 1951. It was brought up-to-date in 1952 and published in English. It is proposed to publish it in French and Spanish in 1953.

(Continuing from 1951 to 1953)

5. Regional Activities

The Director-General maintains officers, permanently assigned, especially for fisheries work in Europe and the Near East, Latin America, Asia and the Far East. (Budgetary limitations prevent the assigning of officers to other regions at this time). Their duties include the giving of advice, as falls within their competence, to fisheries administrators and technicians on request. Regional fisheries councils are already in operation in south-east Asia (the IPFC) and in the Mediterranean region (General Fisheries Council for the Mediterranean). An agreement has been reached on the establishment of a Council for Latin America and has been submitted to governments for acceptance.

Much of the program initiated by the Headquarters' Secretariat is implemented in the regions. It falls to the regional fisheries staff to act as the principal fisheries intelligence agents and to assist in implementing these programs wherever possible and feasible. The general duties of all regional staffs are as follows :

1. to engage in preparatory work with governments on the establishment of regional fisheries councils and to act as their secretariat on their establishment ; to service their executive and special committees and to prepare the records of proceedings ;

2. to provide advice and assistance to Member Governments in connection with the application of projects outlined under fisheries biology, technology and economics ;
3. to supply advice and assistance to Member Governments in drawing up plans for administrative and development services in fisheries, notably in the less developed areas ;
4. to provide fisheries intelligence and contacts required by Headquarters ;
5. to assist Member Governments in the planning of projects under ETAP.

5.1 *Asia and the Far East*

Fish plays a very important role in the nutrition of the people of Asia and the Far East but, even though large quantities are landed, these areas must be considered as under-developed as regards fisheries. The traditional methods of the fisherman and fish cultural practices must be improved. Much remains to be done for transport, storage and marketing of the commodity. Indeed, the distributive mechanism is often the " bottleneck " to a larger production and consumption of fisheries products (*see* 4.3.).

Certain governments need assistance with the development of fisheries administrative services and policies. The importance of the role of practical education and training of government officers, assigned to field work cannot be over-estimated and extension work amongst the fishermen and fish farmers will be of considerable significance in raising production. The general program of fisheries work in this region and the activity of the FAO regional fisheries staff is governed by such considerations.

Regional fisheries councils, of which the IPFC is already established, are designed to promote, on a regional basis, a co-operative approach amongst governments to their fisheries problems. This is accomplished by exchange of information and experience, the planning of projects of common interest, and by bringing together the leaders in these fields. FAO regional fisheries officers act as secretaries for such councils and as technical advisers on projects proposed.

Technical Assistance Projects

Fish Culture Seminar held in Indonesia, May to June 1952.
Fisheries Statistics Training Center in Bangkok, Thailand, June to July 1952.
Training Center for Fisheries Officers, India, 1953.
Training Center for Master Fishermen, possibly in Ceylon, 1953.

5.1.1 *Indo-Pacific Fisheries Council (IPFC)*

The IPFC came into being in 1949 at a meeting held in Singapore. The second annual meeting of the Council was held in Cronulla, Australia, and the third regular meeting in Madras, India, in February 1951.

The next regular meeting will be held in the Philippines in late 1952. The proceedings and reports of the Council are published annually.

Specific work projects of the Council, as agreed at its 1951 annual meeting, include the following :

1. surveys of fishing gear and methods employed for its preservation and programs for the introduction of non-indigenous gears ; the purpose of this project, which will be carried out in co-operation with the Headquarters' Technological Branch, is to enable countries in the region to benefit from experience already gained not only in the Indo-Pacific regions, but also in other regions of the world ;
2. bibliographies on :
   (*a*) tuna fisheries, to be prepared by the U.S.A. ;
   (*b*) Chanos Chanos culture, to be prepared by Indonesia ;
   (*c*) hydrology, to be prepared by Australia ;
   (*d*) plankton (a revision), to be completed by India ;
3. planning and organization of training centers for fisheries workers in the fields of fish culture, statistics, etc., e.g. Fish Culture Seminar held in Bogor, Indonesia, May to June 1952 and the Fisheries Statistics Training Center in Bangkok, Thailand, June to July 1952.

(Continuing project)

5.2 *Europe and the Near East*

The General Fisheries Council for the Mediterranean began functioning in 1952 and one of the Headquarters' officers performs the secretarial duties. The Council gives particular attention to fisheries development projects in the Near East where there are considerable potentialities for expanding both salt water and fresh water fisheries.

The Headquarters' staff of the Fisheries Division has direct contact with European countries. Collaboration with European organizations, such as OEEC and ICES, and the servicing of the Committee on Fish Handling and Processing is referred to in other sections of the Fisheries Program.

Technical Assistance Projects

Fish Culture Training Center, possibly in Israel, October 1953.

5.2.1 *General Fisheries Council for the Mediterranean*

The functions of this Council generally are the same as those of the Indo-Pacific Fisheries Council. An agreement was formulated in Rome in September 1949 for the establishment of this Council and, following the approval of the Fifth Session of the Conference, the agreement was submitted to governments for acceptance. The Council came into being in February 1952 on receipt of the fifth notification of acceptance and the initial meeting was held in Greece in late July.

(Continuing project)

5.3 *Latin America*

Many Latin American countries possess rich and under-developed fisheries resources and have the possibility of new developments in the estuarine fisheries and in brackish- and fresh-water fish culture. Fish could supply much-needed animal proteins to the diet of the people, as well as furnishing products for export. However, in most of the countries the inhabitants are traditionally not fish eaters. Furthermore, tropical climates and inadequate transportation systems make wide distribution of fisheries products extremely difficult.

The part which FAO may play in the development of these fisheries resources at the request of the governments concerned is to secure the application of existing knowledge to local problems, as well as to promote work which will fill gaps in information, especially regarding the extent of fisheries resources, also to encourage practical education and education and extension work.

Some of this can best be done by establishing a means for co-operation between fisheries workers as may be brought about by the formation of a fisheries council or councils in the region and through technical aid in existing or contemplated fisheries projects. The regional staff will be engaged in the application of the above work with the help of Headquarters' officers.

Technical Assistance Projects

Latin American Fisheries Training Center held in Valparaiso, Chile, January-March 1952.

Latin American Fisheries Training Center, possibly in Mexico, June to July 1953.

5.3.1 *Regional Fisheries Council for Latin America*

The FAO conference at its Fifth Session approved the Director-General's plan to initiate a regional fisheries council in Latin America. At a meeting of Latin American countries, held in Montevideo in December 1950, FAO was again urged to establish such a council as quickly as possible. Accordingly, the Director-General convened a meeting in Lima, Peru, 17-22 September 1951, where an agreement was reached to establish a council. This agreement, approved by the Conference at its Sixth Session, was submitted to interested governments for acceptance and it is expected the council will come into operation in late 1952.

(Continuing project)

Notes on Publications

FWS 9.4 SOCIETIES – U.S.A. UDC 0.6 (73)

United States Department of the Interior, Fish and Wildlife Service.
1952 List of Fishery Associations in the United States, Alaska and Hawaii. *Fishery Leaflet* 254. Washington 25, D.C., U.S.A. Revised March 1952. 8 pp. Mimeo. In English. Free.

Lists associations of fishermen, seafood packers, canners, dealers, fish culturists, boat owners, importers, pearl button manufacturers, and professional societies in the U.S.A., Alaska and Hawaii.

FWS 9.6 PUBLICATIONS UDC 05

Indo-Pacific Fisheries Council. Biblioteca Bogoriensis. *Occasional*
1952 *Paper* 52/10. FAO Regional Office for Asia and the Far East, Maliwan Mansion, Phra Atit Road, Bangkok, Thailand. 15 pp. Mimeo.

A list of publications received regularly by the library of the Botanical Gardens in Java.

FWS 9.6 PUBLICATIONS – JAPAN UDC 05 : 639.2 (52)

Yoshihara, T., and Oshima, Y. First Draft of the List of Periodi-
1952 cals in Japanese Fisheries. Department of Fisheries, Tokyo University (?), Tokyo, Japan. 72 pp. In Japanese.

Lists the Japanese periodicals on fisheries published since 1880. Gives the title, name of publishers, and date of first issue.

FWS 9.2 FISHERIES STATISTICS – NORTH ATLANTIC OCEAN UDC 31 : 639.2 (261)

Rosén, Nils (Editor). *Bulletin statistique des pêches maritimes des pays*
1951 *du nord et de l'ouest de l'Europe* [Marine Fisheries Statistical Bulletin for the Countries of Northern and Western Europe] (Conseil permanent international pour l'exploration de la mer, Charlottenlund Slot, Charlottenlund, Denmark), Vol. 33, 1948. x + 39 pp. In English. Price : D. Kr. 8.

Contains a brief summary of selected statistical data, annual and monthly, on 1948 landings from the North Sea for selected species (including herring) and countries in the region. The tables are broken down by countries and species with the values and quantities of landings specified by areas of catch, and include other basic data which are very useful for the computation of fishing effort rates. A nomenclature of fish names in different languages together with their scientific names is included.

FWS 9.4 FISHERIES ADMINISTRATION – UNITED KINGDOM UDC 35 : 639.2 (410)

White Fish Authority. First Annual Report and Accounts for the 1952 Period ended 31st March 1952. H. M. Stationery Office, London. 28 pp. Price : 1s. net.

The report of the White Fish Authority, which is charged with reorganizing, developing and regulating the white fish industry in the United Kingdom, analyses briefly the problems affecting the inshore, near, middle and distant water fishing fleets, marketing and distribution and some of the measures proposed for their solution. Contains a short account of research and training activities, selected statistical tables and a statement of accounts.

FWS 9.1 FRESH WATER BIOLOGY UDC 57

Fresh Water Biological Association. Twentieth Annual Report for 1952 the Year ending 31st March, 1952. The Ferry House, Far Sawrey, Ambleside, Westmoreland, England. 49 pp. In English.

Account of activities of officers, councils and committees of the British Fresh Water Biological Association during the fiscal year 1951-52. Includes a complete list of members. Also gives a review of the scientific work of the staff carried out at Windermere on matters referring to hydrobiology, algology, mycology, microbiology, invertebrate zoology and fish.

FWS 9.1 FRESH WATER BIOLOGY UDC 57

Lagler, K. F. Fresh Water Fishery Biology. Wm. C. Brown Company, 1952 Dubuque, Iowa, U.S.A. x + 360 pp., 172 fig., 5 app. In English. Price : $5.75.

A revised edition of the author's *Studies in Freshwater Fishery Biology*, published in 1947. A comprehensive volume dealing with the principles and methods of modern fisheries research and management of inland water. Covers natural history and ecology of the fresh-water fishes of North America, anatomy and embryology, food habits, and age and growth determination. Describes methods of population and yield analyses and gives information on fish pathology and pollution. Survey and improvement of lakes, streams and ponds are dealt with in special chapters. Commercial and recreational fisheries and fish culture are treated elaborately in the well documented book which completely reviews the methods commonly used and practices in fresh water fisheries research in North America.

FWS 1.0118 FISHES UDC 597

Jobes, Frank W. Age, Growth and Production of Yellow Perch 1952 in Lake Erie. *Fishery Bulletin* 70. United States Department of the Interior, Fish and Wildlife Service, Washington, D.C., U.S.A. 102 pp. In English. Price : $0.20.

Reports on investigations on *Perca flavescens* as part of an extensive study of the Lake Erie commercial fisheries by the U.S. Fish and Wildlife Service. Age determination and measurements of scales have been made of about 4,000 fishes. Analysis of length/weight relations was based on 23,000 specimens, and length/frequencies have been compiled from measurements of about 60,000 individuals. Also discusses discrepancies in the calculated growth in all years of life and the chief contributing causes ; growth of the species in Lake Erie compared with other waters ; and sex ratio findings.

FWS 1.015 FISHES – CEYLON UDC 597 (548.7)

Deraniyagala, P.E.P. A Coloured Atlas of some Vertebrates from
1952 Ceylon. Vol. I. *Ceylon National Museum Publication.* Colombo, Ceylon. 150 pp., 39 pl., 60 figs., bibl., index. In English.

A taxonomic description of the fresh water fishes and of a few representative marine species occurring in Singhalese waters. Gives the indigenous names and keys for identification. Contains colored plates and black and white figures of fishes described in the text.

FWS 1.6 FLATFISHES UDC 597.5

Hagermann, F. B. The Biology of the Dover Sole, *Microstomus*
1952 *pacificus* (Lockington). *Fish Bulletin* No. 85. California Department of Fish and Game, Bureau of Marine Fisheries, San Francisco, California, U.S.A. 48 pp., illus., tables, bibl. In English.

Facts on the biology of the Dover sole (*Microstomus pacificus*) are presented as a result of investigations carried out in 1948/49 on material collected along the Californian coast. Food habits, migrations, development, fecundity, lengthweight relationships and lengthfrequencies are dealt with in separate chapters. Also contains data on the trawl fishery which the Dover sole supports.

FWS 2.115 NAVAL ARCHITECTURE UDC 629.124.72

Japan. Fisheries Agency. *Illustrations of Japanese Fishing Boats.* 2,2-Chome,
1952 Kasumigaseki, Chiyoda-ku, Tokyo, Japan. 311 pp., illus. In Japanese and English.

This unprecedented book will be of the greatest interest to those concerned with the design, construction and operation of fishing vessels. It contains unusually complete details, and a wealth of plans of 47 different types of Japanese craft, both wood and steel, ranging from a 176 m. whale factory ship to a 13 m. fisheries training boat. The majority of the vessels illustrated have been built since 1947.

The contents include, for each of the 47 vessels, a photograph; a table of dimensions, equipment, capacities, the draft, trim, displacement, coefficients, location of centers of gravity and buoyancy, and metacentric height, for both light and full load condition; and trial results. The plans reproduced are unusually complete: for example, those of a 300 ton steel diesel trawler include a general arrangement, construction sections and scantling list, lines and offsets, hydrostatic curves, stability curves, fishing gear arrangement, arrangement and details of fish hold insulation, engine room arrangement, piping arrangement; and refrigerating piping arrangement.

FWS 1 FISHERIES – BIBLIOGRAPHY UDC 639.2 (01)

Indo-Pacific Fisheries Council. List of Periodical and Serial Hold-
1952 ings, etc. of the Pacific Oceanic Fishery Investigation Library, Honolulu. *Occasional Paper* 52/12. FAO Regional Office for Asia and the Far East, Maliwan Mansion, Phra Atit Road, Bangkok, Thailand. 7 pp. In English. Free.

Lists periodicals, serials and reference books, mainly biological, held in the Pacific Oceanic Fishery Investigation Library of the United States Fish and Wildlife Service in Honolulu.

FWS 1 FISHERIES INDUSTRIES – GERMANY UDC 639.2 (43)

Schleswig-Holstein, Ministerium für Ernährung, Landwirtschaft und For-
1952 sten. Fisch und Wirtschaft in Schleswig-Holstein [Fish and the Economy of Schleswig-Holstein]. Mühlenweg 166, Kiel, Germany. Sept. 1952. 102 pp., illus. In German.

A review of the development of the fishing industry in Schleswig-Holstein since 1946 ; consists of 46 short articles by scientists and industrial and governmental authorities under 6 main headings : Inland Fisheries ; The Baltic Sea and its Fisheries ; North Sea Fisheries ; Fish Utilization ; Fisheries Education ; Auxiliary Industries. Provides an accurate cross section of the primary (fishing), secondary (fish processing) and tertiary (fish marketing) phases of the whole industry, including fisheries research and the auxiliary industries (boat industries, manufacture of marine engines and navigational and fish detection apparatus ; fishing gear, ice, fuel, can making, and processing machines industries).

FWS 1 FISHERIES – INDIA – BIBLIOGRAPHY UDC 639.2 (54) (01)

Hora, S. L. Bibliography of Indian Fisheries Literature published
1952 in the year 1951. *Occasional Paper* 52/11. Indo-Pacific Fisheries Council, FAO Regional Office for Asia and the Far East, Maliwan Mansion, Phra Atit Road, Bangkok, Thailand. 10 pp. Mimeo. In English. Free.

Lists of articles published on Indian fisheries which appeared in various periodicals, and IPFC technical papers, in 1951.

FWS 1.015 FISHERIES – CEYLON UDC 639 2 (548.7)

De Zylva, E.R.A. Administration Report of the Acting Director
1952 of Fisheries for 1951. Government Publications Bureau, Colombo, Ceylon. 30 pp., tables. In English. Price : 65 Ceylon cents ; postage 10 Ceylon cents.

Follows the same pattern as the earlier Reports of the Acting Director of Fisheries (*see FAO Fisheries Bulletin*, Vol. 5, No. 2 p. 92; No. 5, p. 211).

FWS 9.16 FISH CULTURE – MALAYA UDC 639 2 (595)

De Zylva, E.R.A. Fish Farming in Malaya (as a guide to fishing
1952 farming in Ceylon). Ceylon Government Press, Colombo, Ceylon. 9 pp., illus., bibl. In English.

A report on fish culture in Malaya ; deals with the types of fish used for farming, the construction and operation of ponds, the trade in fry between China and Singapore and the cultural methods applied in farming Chinese carps.

FWS 1 FISHING – WEST AND EQUATORIAL AFRICA UDC 639 2 (66/675)

Boavida, Joaquim G. Roteiro de Pesca de Arrasto do Cabo Juby e do
1949 Cabo Branco [Guide to the Trawler Fishing off Cape Juby and Cape Branco]. Boletím da Pesca, Lisbon, Portugal. 334 pp ; charts and illus. In Portuguese.

A study sponsored by the Portuguese Trawler Owners' Corporation (Gremio dos Armadores da Pesca de Arrasto), it is the result of the author's observations and research carried out on board units of the Portuguese

trawler fishing fleet operating off Capes Juby and Branco. Contains a detailed account of the location and limits of the trawler fishing grounds and their most important geographical characteristics (i.e. sea grounds, depth, etc.) with practical instructions on how to operate trawling gear in each ground.

FWS 1 FISHERIES – CARIBBEAN ISLANDS UDC 639.2 (729)

1952 Caribbean Commission. Fisheries in the Caribbean. Report of the Fisheries Conference held at Kent House, Port-of-Spain, Trinidad, 24 48 March 1952. 170 pp., tables, appendices, bibl. Offset print. In English. (Also French edition, 184 pp.).

Reports and proceedings of Caribbean Fisheries Conference (*see FAO Fisheries Bulletin*, Vol. 5, No. 2, pp. 81-82), with conveniently tabulated summaries of the present position, special problems and recommendations on many fisheries matters, including the occurrence and distribution of commercial species of fish and shellfish in the Caribbean ; fishing methods and fishing craft in use ; marketing, storage and distribution of fish and fish products ; processing methods ; pond fish culture ; and the application of recent technical knowledge about the exploitation and development of new fisheries. Tabulates statistics on catches (British Guiana deep-sea fishery) ; fishermen and craft throughout the area ; fishing gear ; imports and their *per capita* consumption breakdown ; and exports. There are a number of tables on Puerto Rican fisheries.

The reports conclude with a tabulation of colloquial and systematic names of all species of commercial marine and fresh water fish and shellfish reported in the Caribbean.

FWS 9.4 FISHERIES – U.S.A. UDC 639.2 (73)

1952 Louisiana State Department of Wild Life and Fisheries. Fourth Biennial Report, 1950/1951. 126 Civil Courts Building, New Orleans, Louisiana, U.S.A. 482 pp., illus. In English.

Contains information on the activities of the various departmental divisions, including Fresh and Salt Water Fisheries. Contains a short description of the limnological factors controlling the fish production of Louisiana inland waters and special chapters on lake managements and improvement, fertilization of natural waters and control of aquatic plants and predators. The marine section gives information on fish and shrimp production, size and number of fishing vessels and tax and licensing revenues. Also contains sections on the crab fishery and crayfish industry.

FWS 1 FISHERIES – U.S.A. UDC 639.2(73)

1952 Rostlund, E. Freshwater Fish and Fishing in Native North America. University of California Press, Berkeley and Los Angeles, California, U.S.A. 313 pp., 47 maps, bibl. In English. Price : $3.50.

An analysis of the fisheries resources utilized by the North American Indians in aboriginal times, with an evaluation of the fishing opportunities on a quantitative basis. Investigations on the co-existence of certain food fishes in a region and their absence from others lead to descriptions of 12 "fish provinces" characterized by the occurrence of similar stocks of fresh water and anadromous species. An explanation of the regional and seasonal differences is given and the results of the investigations are cartographically represented.

Evidence on fishing methods, artifacts and customs have been used as clues to routes and directions of movements in culture history. Arti-

facts, grouped with reasonable accuracy to geographical origin, make it likely that the oldest date line for true fishing implements in North America was 4,000 to 5,000 years ago.

FWS 9.4 FISHERIES – ECUADOR UDC 639.2 (866)

Ecuador, Ministro de Economía. Informe a la Nación [Ecuador,
1952 Minister of Economics Report to the Nation], 1951-1952, Quito, Ecuador. xxviii + 280 pp. In Spanish.

Annual reports of the various departments under the Ministry of Economics. Includes a 24-page report outlining the policies followed during the year by the Fish and Wildlife Service regarding the main problems of the fishing industry and the principal tasks that will have to be faced in the future in the Department's fields of responsibility. Also deals with problems related to the application of the 1951 Fish and Wildlife Conservation and Development Law, legislation in connection with contracts for the implementation of several fisheries development projects now under way, the results of FAO's ETAP Fisheries Mission in the country and the participation of Ecuadorian delegates in the first Latin American Training Center in Chile, sponsored by FAO.

FWS 1 FISHERIES – VENEZUELA UDC 639.2 (87)

Venezuela, Ministerio de Agricultura y Cría, División de Pesca. [Venezuela,
1952 Ministry of Agriculture and Animal Husbandry, Fisheries Division] *Boletín de Pesca* No. 1. Caracas. 16 pp., 7 fig., 2 tables. In Spanish.

The first of a new series apparently to be issued occasionally. No. 1 gives preliminary observations on experimental shrimp fishing off the coast of the State of Anzoátegui, Venezuela.

FWS 2.111 PRESERVATION OF FISHING GEAR UDC 639.2.081

Datingaling and Sulit. Bibliography of Fishing Gear Preservatives.
1952 *Occasional Paper* 52/10. Indo-Pacific Fisheries Council, FAO Regional Office, Maliwan Mansion, Phra Atit Road, Bangkok, Thailand. 2 pp. Mimeo. In English. Free.

A provisional bibliography of fishing gear preservatives compiled by two members of the staff of the Bureau of Fisheries, Manila, Philippines. Covers publications in English, mainly U.S. and Canadian. The authors invite additions to the lists.

FWS 1.5 FISHING – COD, HAKE, ETC. UDC 639.223 (261)
– NORTH ATLANTIC OCEAN

Boavida, Joaquim G. Roteiro de Pesca dos Bancos da Terra-Nova e
1950 da Groenlandia [Guide to the Fishing Activities on the Newfoundland and Greenland Banks]. *Publicação* No. 5. Gabinete da Estudos das Pescas, Lisbon, Portugal. 438 pp., charts and illus. In Portuguese.

Oceanographic study sponsored by the Board for Fisheries Studies (Gabinete de Estudos das Pescas) of the grounds off Newfoundland and Greenland most frequented by the Portuguese cod fishing fleet. Contains detailed description, by fishing grounds, of the geography, geo physics and oceanography of the area with emphasis on basic technical information on harbors and the ecology and taxonomy of cod and similar species for the practical use of the cod fishermen. An Appendix supplies current oceanographic and navigational data in tables.

FWS 1.8 FISHERIES INDUSTRIES – CRUSTACEANS – BELGIUM UDC 639.28(493)

Gilis, Charles. La pêche crevettière sur la côte belge : son évolution au
1952 cours des années 1935-1951 et son influence sur le stock de la crevette [Shrimp Fishery off the Belgium Coast : Its Evolution during 1935-1951 and its Influence on Shrimp Stocks]. *Memoire* No. 8. Institut d'études maritimes, Ostende, Belgium. 53 pp., 1 plate. In Dutch and French.

A technical account of the shrimp fishery off the Belgian coast, giving the grounds, fleet and gear, and yields for the period 1935-1951 in relation to the factors which could influence the efficiency of these operations. The annual fluctuation in yield is discussed in terms of hydrographical conditions and of enemies of the shrimp ; the progressive regression of the shrimp production is discussed in relation to the destructive action of the shrimp trawl.

FWS 1.9 LIVE STORAGE OF AQUATIC ANIMALS – MISCELLANEOUS FISHES UDC 639.37

Tester, Albert L. Establishing Tuna and Other Pelagic Fishes
1952 in Ponds and Tanks. *Special Scientific Report : Fisheries* No. 71. United States Department of the Interior, Fish and Wildlife Service, Washington 25 D.C., U.S.A. 20 pp., illus., bibl. In English.

Report on attempts to catch tuna (skipjack, yellow fin, small tuna and frigate mackerel) alive in order to establish them in ponds and tanks at the Coconut Island branch of the Hawaii Marine Laboratory. The objective was to hold tuna in confinement for an extended period of time, thus providing material for studies on their behavior, feeding, growth and reaction to stimuli. The experiments were partly successful as only small tuna and yellow fin became adjusted to retention in ponds.

FWS 2.6 FISH TRADE – ITALY UDC 658.6 (45)

Associazione Nazionale Importatori Prodotti della Pesca. Relazione della
1951, attività svolta dall'Associazione nell'anno [Report on the
1952 Activity of the National Association of Importers of Preserved Fisheries Products], 1950, 1951. Rome, Italy. 144 pp., 105 pp. In Italian.

Follows the same pattern as the 1949 Report (*see FAO Fisheries Bulletin*, Vol. 5, No. 1, p. 39).

FWS 3.30 CANNED FOOD – U.S.A. UDC 664.8.036.5 (73)

The Canning Trade Almanac 1952. 37th ed. *The Canning Trade*,
1952 20 S. Gay St., Baltimore 2, Maryland, U.S.A. 340 pp. In English. Price : $2.00.

Follows the same pattern as the 1951 Almanac (*see FAO Fisheries Bulletin*, Vol. 4, No. 4, p. 47).

FWS 0.6 FISHERIES RESEARCH – TECHNOLOGICAL – DENMARK UDC 664.95.001.5 (489)

Denmark, Fiskeriministeriets Forsøgslaboratorium. Årsberetning [Annual Report of the Technological Laboratory of the Danish Ministry of Fisheries] 1951. Fiskeriministeriets Forsøgslaboratorium, Øster Volgade 10, Copenhagen, Denmark. 30 pp. In Danish.
1952

A review of the work carried on at the Laboratory, including the main conclusions drawn from the various experiments.

FWS 4 OILS AND FATS UDC 665

B.E. Bailey (Editor). Marine Oils with Particular Reference to Those of Canada. *Bulletin* No. 89. Fisheries Research Board of Canada, Ottawa, Ontario, Canada. 413 pp., illus. In English. Price : $3.00 (Clothbound $4.00).
1952

A revised edition of *Bulletin* No. 59, "The Chemistry and Technology of Marine Animal Oils with Particular Reference to Those of Canada" also prepared by staff members of the Pacific Fisheries Experimental Station.

In 12 chapters it deals with the general chemistry of marine oils and fats, the nature of component fatty acids and composition of marine oils, vitamins and other non-fat components of marine oils, metabolism of fats, chemical reactions and physical properties of fats and oils, deteriorative changes in marine oils, production of marine oils, refining and processing of marine oils, commercial utilization of marine oils, properties of some Canadian marine oils, significance of analytical values and specifications for marine oils in 13 countries. A subject index is added ; references are listed at the end of each chapter.

FWS 9.7 ATLASES UDC 912

Lloyd's Maritime Atlas, including a comprehensive list of ports and shipping places of the world. Compiled and edited by the Shipping Editor at Lloyd's. The Corporation of Lloyd's, London.
1951

The book is in three sections ; the first consists of 16 maps, showing towns situated on the coast or on navigable rivers ; the second consists of a list, in geographical order according to Lloyd's system, of the places shown on the maps, arranged in numbered columns ; the third is an alphabetical list of names of places which appear in the other sections. It is a guide for shipping agents, brokers and all whose commerce concerns the seafaring places of the world.